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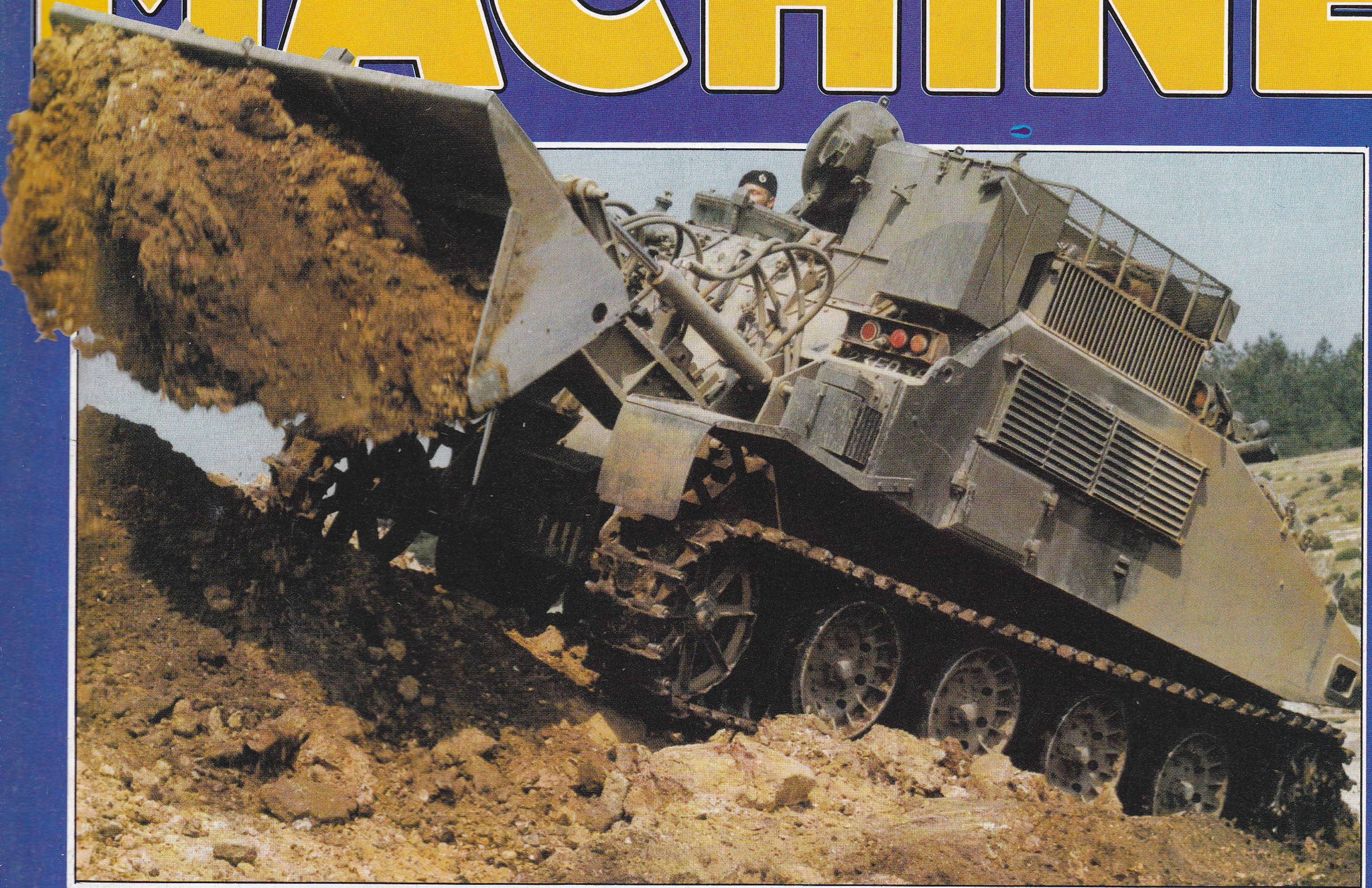

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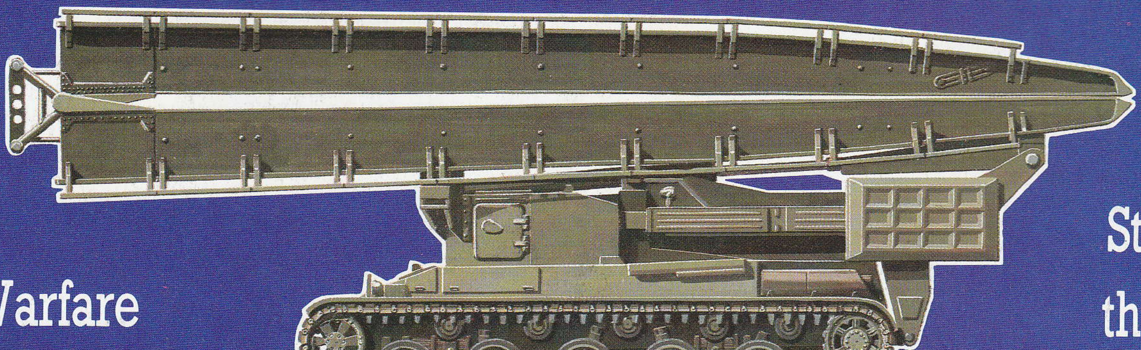

Mine Warfare

Storming the Canal

A fully illustrated guide to Modern Combat Engineer Equipment

WAR MACHINE

Volume 9 **Issue 98**

Published by
Orbis Publishing Ltd
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18857

Printed in Great Britain
by The Artisan Press Ltd

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WAR MACHINE
Forthcoming issues feature:
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Picture acknowledgements

Cover photograph: R.F. **1941:** R.F./R.F. **1942:** R.F./R.F. **1943:** R.F./R.F. **1944:** Robert Hunt Library/R.F. **1945:** R.F. **1946:** R.F./R.F. **1947:** R.F./R.F./R.F. **1948:** R.F./R.F. **1949:** R.F. (four). **1952:** R.F./R.F. **1953:** R.F./US Department of Defense/Finnish Army. **1954:** R.F./R.F. **1955:** R.F./R.F./R.F. **1957:** R.F. **1958:** R.F. **1959:** R.F./R.F./R.F. **1960:** R.F./R.F. **(iii):** US Navy/Bruce Robertson. **(iv):** Royal Navy/US Navy.

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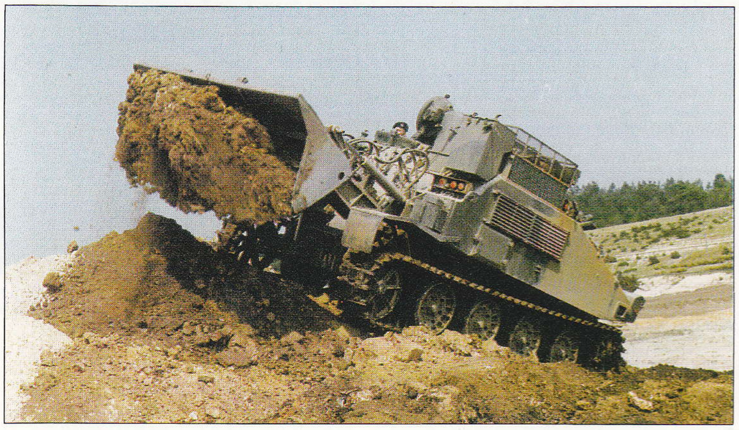
Modern Combat Engineer Equipment



A Combat Engineer Tractor uses its hydraulically-operated bucket to move soil. The bucket can also be used as an earth anchor when the winch is being deployed. When afloat, the Combat Engineer Tractor is powered by a water jet on each side.

Engineers use some of the most unusual equipment in the armed forces' inventories, ranging from conventional construction machines to special-purpose AFVs designed to lay down bridges, bury mines, rip up roads or excavate tank firing positions. The sheer variety of specialist equipment is testimony to the crucial importance of combat engineering on the battlefields of today.

The combat engineer of the 1980s is one of the most highly trained members of any modern army. His duties include detecting and clearing anti-tank and anti-personnel minefields, laying minefields, demolition work, airfield construction, rapid runway repair, laying bridges for forward elements, repairing bridges, and preparing weapon pits and trenches to name but a few.

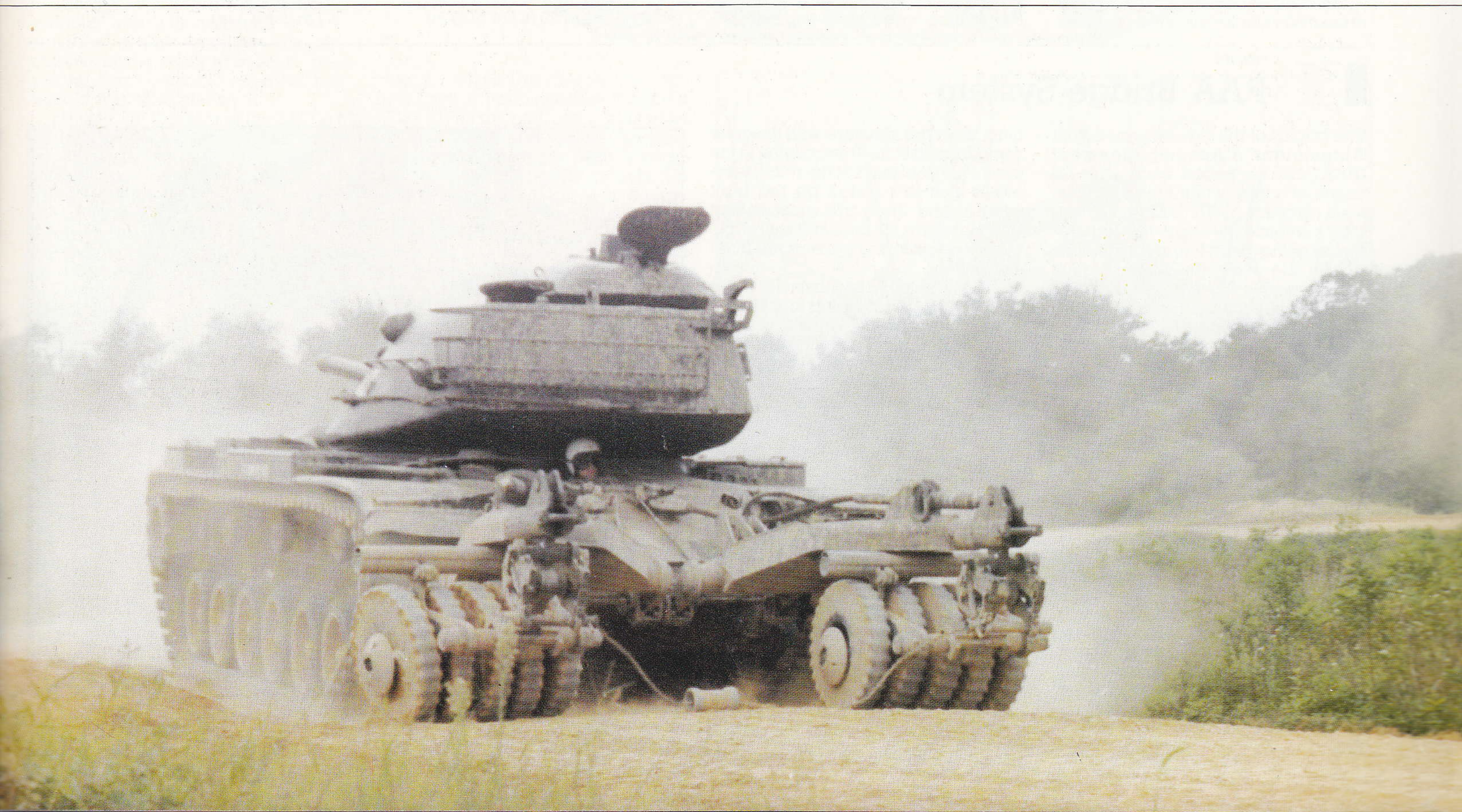
To carry out these missions combat engineers have a very wide range of equipment. Some items, such as the Combat Engineer Tractor (CET) or Counter Obstacle Vehicle (COV), have been developed specifically for military use, but much of the equipment used in military construction work is normally standard civil equipment with little if anything in the way of modification to suit it for service use.

The one area in combat engineering that is receiving more attention than ever is mine warfare. This field covers not only the laying of mines by individuals but also by helicopters, rockets, artillery and ground-based launchers; and their detection and clearance in the shortest possible time with the minimum of casualties. In conflicts such as those in South Vietnam, the Middle East, Namibia and more recently the Falklands, mines have been a major problem.

Military bridging has also been revolutionized in recent years with the introduction of systems such as the British Medium Girder Bridge (MGB) and the Soviet PMP heavy folding floating bridge. The latter is so successful a design that the Americans have improved it even further and it is now in service with the US and some NATO armies as the Ribbon Bridge!

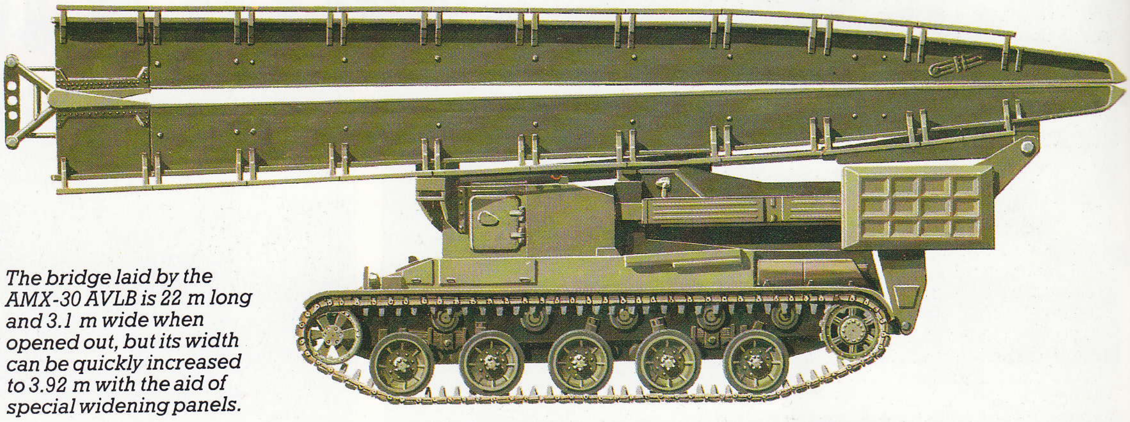
Within this study there is space only to highlight some of the more important items of combat engineer equipment in service today.

An M60A1 of the United States Army clears a road of anti-tank mines with its front-mounted roller system. The Soviets have been using similar systems for many years, but it is only recently that the United States Army has bought these in significant numbers.

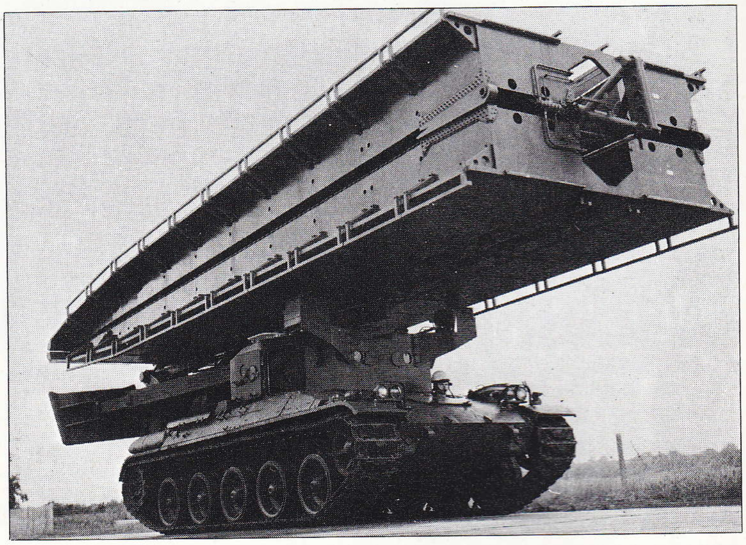


FRANCE

AMX-30 Armoured Vehicle-Launched Bridge



The bridge laid by the AMX-30 AVLB is 22 m long and 3.1 m wide when opened out, but its width can be quickly increased to 3.92 m with the aid of special widening panels.



An AMX-30 armoured vehicle-launched bridge is seen in travelling mode. This chassis is almost identical to that of the MBT with which it has been designed to operate, so that both vehicles have similar cross-country performance. Maintenance and operations are thus simplified.

For many years the only armoured bridgelayer in service with the French army was the **AMX-13 Char Poseur de Pont (CPP)**. This is essentially an AMX-13 light tank chassis with turret removed and fitted with a scissors bridge which is laid hydraulically over the rear of the vehicle. Opened out the bridge is 14.3 m (46 ft 11 in) long and can take vehicles up to Class 25, well below the weight of the American M47 tanks which were the standard tanks of the French army at the time of the CPP's debut. To allow the M47 tank to cross, two bridges were laid side by side.

The prototype of a new bridgelayer based on the chassis of the AMX-30 tank was completed in the mid-1960s, but for a variety of reasons it was some 10 years before the first production **AMX-30 CPP** vehicles were delivered to the French army. The chassis of this AMX-30 bridgelayer is built by the Atelier de Construction Roanne (ARE), the only MBT plant in France, while the bridge itself is made by Titan, which also builds many of the trailers used by the French army.

The overall layout of the AMX-30 armoured bridgelayer is almost identical to that of the MBT, with the driver seated at the front, the commander and bridge operator accommodated in the centre, and the engine and transmission located at the rear. Like that of the older AMX-13 CPP, the scissors bridge of the AMX-30 CPP is laid hydraulically over the rear of the vehicle and takes about 5 minutes to position and a similar time to be recovered. Like most bridges of this type it can be laid and recovered from either end. Opened out, the bridge is 22 m (72 ft 2 in) long and can span a gap of 20 m (65 ft 7 in), a considerable improvement over the older AMX-13 armoured bridgelayer. In position the bridge is 3.1 m (10 ft 2 in) wide, but with the aid of widening panels this can be quickly increased to 3.92 m (12 ft 10.3 in).

Standard equipment for the AMX-30 armoured vehicle-launched bridge includes an NBC system and night-vision equipment. No armament is installed as other armoured vehicles, such as tanks, would normally be in a position to give covering fire. A major disadvantage of armoured bridgelayers such as the French AMX-13/AMX-30 and British Chieftain derivatives is that when the bridge is being positioned, i.e. being laid through 180°, its position can be easily detected by the enemy. Other bridgelayers, such as the Soviet MTU-20 and the West German Biber, lay their bridges horizontally so as not to give away their position so easily.

Specification

AMX-30 CPP

Crew: 3

Weight: 42500 kg (93,696 lb)

Powerplant: one Hispano-Suiza HS-110 12-cylinder multi-fuel diesel developing 522.0 kW (700 hp)

Dimensions: length (with bridge) 11.40 m (37 ft 4.8 in); width (with bridge) 3.95 m (12 ft 11.5 in); height (with bridge) 4.29 m (14 ft 0.9 in)

Performance: maximum road speed 50 km/h (31.1 mph); maximum range 600 km (373 miles); fording 1.0 m (3 ft 4 in); gradient 60 per cent; vertical obstacle 0.93 m (3 ft 0.6 in); trench 2.9 m (9 ft 6.2 in)

FRANCE

PAA Bridge System

The PAA self-propelled bridge system was built for the French army engineers by the Direction des Constructions et Armées Navales at Lorient, although the first prototypes were built by the West German company of EWK during the 1960s.

The origins of the French army's **Pont Automoteur d'Accompagnement (PAA)** can be traced back some 20 years, to a time when the West German company EWK built three prototype vehicles to meet the requirements of the French army engineers. In the late 1960s the Etablissement d'Expériences Techniques d'Angers and the Direction des Constructions et Armes Navales carried out a complete redesign of the vehicle, after which two prototypes were built, the latter being completed in 1970. Two years later the PAA was accepted for service with the French army, and production got under way at Lorient in 1973. First production vehicles were delivered to the French army in 1974 and production has now been completed. The PAA was offered overseas but no sales were made.

The PAA can be used in two roles: it can lay its bridge in position in the same way as a conventional bridgelayer and then withdraw to the rear, or it can lay its bridge in position and remain to the rear and act as the ramp, especially when the far bank is higher.

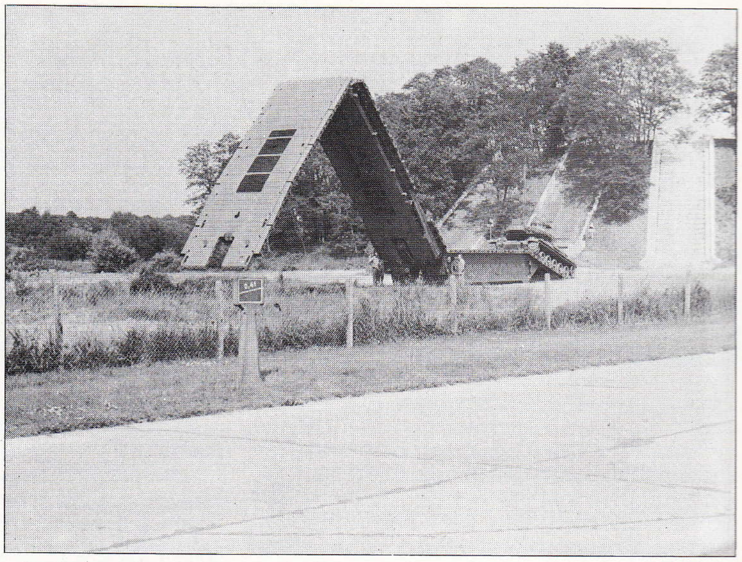
The hull consists of a large aluminium box-type structure with the crew compartment at the front, engine in the centre and fuel tanks at the rear. Steering is power-assisted on the front wheels, and there are independent brake systems for front and rear. NBC and air-conditioning systems are fitted as standard.

After reaching the obstacle to be crossed, the PAA raises its four wheels clear of the ground and rests on shoes under its hull. The scissors-type bridge is then launched hydraulically over the front of the vehicle. When opened out this has a total length of 21.72 m (71 ft 3 in) and is 3.05 m (10 ft 0 in) wide. With the aid of special widening panels carried on a 6×6 truck the width of the bridge can be increased to 3.55 m (11 ft 7.8 in). If required the widening panels can be carried attached to the bridge, but in practice they are normally removed to reduce the overall width of the vehicle. With the launch vehicle remaining in position as a ramp, soft-banked gaps of up to 17.40 m (57 ft 1 in) can be crossed, while the hard-banked gap capability is 22.40 m (73 ft 6 in).

In combat the PAA would normally replace bridges launched by AMX-30 armoured bridgelayers, which would then move forward. As soon as possible bridges laid by the PAA would be replaced by more permanent and durable structures.

The French army has a number of other bridging systems in service, including the **Castor** light river crossing equipment and the new **CNIM Pont Flottant Motorisé Modèle F1**. The latter is perhaps the French equivalent of the PMP heavy floating bridge, but has a number of advantages: it can be used as a bridge, raft or pontoon. No pontoon boats are required as each centre section has two outboard motors installed.

Specification
PAA
Crew: 4
Weight: 34500 kg (76,059 lb)
Powerplant: one Deutz V-12 diesel developing 223.7 kW (300 hp)
Dimensions: length (travelling) 13.15 m (43 ft 1.7 in); width (travelling) 3.05 m (10 ft 0 in); height (travelling) 3.99 m (13 ft 1.1 in)
Performance: maximum road speed 60 km/h (37.3 mph); maximum range 800 km (497 km); fording 1.5 m (4 ft 11 in); gradient 50 per cent; trench no capability



A French army PAA self-propelled bridge system unfolds its scissors bridge while an AMX-30 MBT waits to cross. The PAA can either help make a longer span, or leave the bridge in position while it moves to the rear.

FRANCE

AMX-30 Combat Engineer Tractor (EBG)

Since the late 1960s the **AMX-13 Engineer Combat Vehicle (Véhicule de Combat du Génie, or VCG)** has been the standard vehicle of its type in the French army. The VCG is based on the AMX VCI infantry combat vehicle, and is fitted with a front-mounted hydraulically-operated dozer blade, an A-frame pivoted at the front of the hull which when in position can lift a maximum load of 4500 kg (9,921 lb), mine detectors, a hammer drill, a power saw and demolition equipment.

In the future the VCG will be replaced by the **Engin Blindé du Génie (EBG)** or **AMX-30 Combat Engineer Tractor** based on the chassis of the AMX-30 main battle tank, of which over 1,000 are in service with the French army.

The EBG is a much more versatile vehicle, and will carry out a wide range of combat engineer roles including laying small minefields, preparing fire positions, clearing battlefield obstacles and so on.

Mounted at the front of the EBG is a hydraulically-operated dozer blade which is used for clearing and earth-moving operations. When its six scarifying teeth are lowered and the vehicle is driven in reverse the dozer blade can be used to rip up the surface of roads to make them impassable to wheeled vehicles. Located internally at the front of the hull is the main hydraulic winch with a capacity of between 15000 and 20000 kg (33,069 and 44,092 lb), which can be used to recover other vehicles.

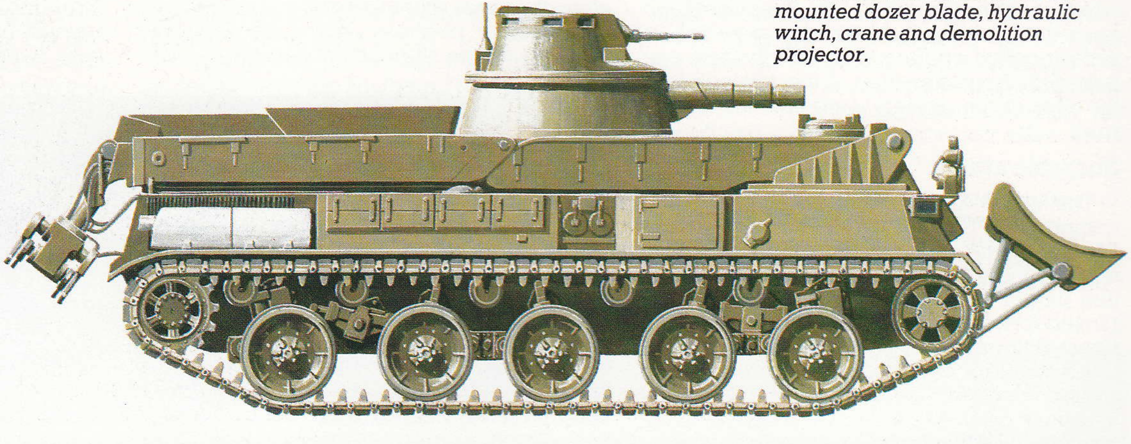
Fitted at the front of the hull on the right side is a hydraulic arm that can be traversed through 360°. In addition to lifting a maximum load of 15000 kg (33,069 lb), the arm can also be fitted with an auger for boring holes in the ground to a depth of 3 m (9 ft 10 in) or a pincer which can be used to rip trees from the ground.

Mounted on the hull top is a one-man turret armed with a 7.62-mm (0.3-in) machine-gun, for which 4,000 rounds of ammunition are carried, and located on each side of the turret are electrically-operated smoke dischargers.

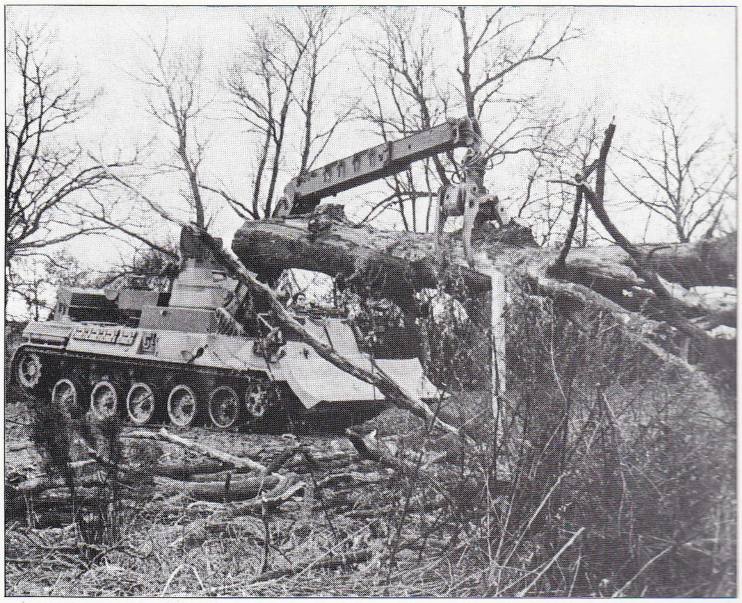
The vehicle is also fitted with a 142-mm (5.6-in) demolition-charge launcher, for which five charges are carried. Each of the charges weighs about 17 kg (37.48 lb) and has a maximum range of 300 m (328 yards). Typically these would be used to destroy bunkers and other battlefield targets. On each side of the demolition-charge projector are two mine-launching tubes, each of which has a container of five mines which fall to the ground and will be activated by any vehicle weighing over 1500 kg (3,307 lb).

Standard equipment for the EBG includes a deep fording kit, an NBC system and night-vision devices.

Specification
AMX-30 EBG
Crew: 3
Weight: 38000 kg (83,776 lb)
Powerplant: one Hispano-Suiza HS 110-2 12-cylinder multi-fuel engine developing 522.0 kW (700 hp)
Dimensions: length 7.90 m (25 ft 11 in); width 3.50 m (11 ft 5.8 in); height 2.94 m (9 ft 7.7 in)
Performance: maximum road speed 65 km/h (40.4 mph); maximum range 500 km (311 miles); fording without preparation 2.50 m (8 ft 2.4 in); gradient 60 per cent; vertical obstacle 0.9 m (2 ft 11.4 in); trench 2.9 m (9 ft 6.2 in)



Currently under development to meet the requirements of the French army engineers is the Engin Blindé du Génie, which features a front-mounted dozer blade, hydraulic winch, crane and demolition projector.



This is one of the two prototypes of the EBG, with the hydraulic crane traversed to the front and fitted with pincers for the rapid removal of tree stumps. The front-mounted dozer blade can be used for clearing battlefield obstacles or to prepare fire positions.

Storming the Canal

The Egyptian army's attack over the Suez Canal in 1973 was a masterpiece of combat engineering: the Israelis had estimated that it would take anything up to two days to bridge the canal, protected as it was by huge banks of sand, but the Egyptian engineers had the troops across in a matter of hours.

In the 1967 Middle East conflict, Israel captured all of Sinai from Egypt and in the next few years built the Bar-Lev Line along the Suez Canal, stretching from Port Said in the north down to Suez in the south. The Bar-Lev Line, named after its originator, was not a continuous line of fortifications, however, but a series of detached forts and observation posts whose main roles were to act as a trip wire and as the eyes and ears of the Israeli artillery and air force.

The size, construction and manpower of the individual fortifications depended on their position and purpose. Most had infantry fighting positions, and were surrounded by barbed-wire entanglements and other obstacles. Deep underground bunkers were provided where the men could rest or take refuge in the event of heavy artillery bombardment. The total length of the Bar-Lev Line from north to south was about 180 km (112 miles).

About 16 km (10 miles) to the rear of the Bar-Lev Line was the Israeli artillery road, which ran almost parallel to the Suez Canal and gave the Israeli army the ability to switch its self-propelled artillery units rapidly from one part of the front to another. A few kilometres to the rear of the artillery road was the supply road.

Surprise attack

The Israeli Sinai Front (or Southern Front) comprised a division under the command of Major-General Mandler with three brigades and just under 300 tanks. Of the three brigades, one (under the command of Reshef) was deployed forward with its main part north of the Great Bitter Lake and detachments all along the canal. The other two brigades were deployed to the rear: the brigade in the north was under the command of Amir and the one in the south under Shamron.

The Egyptians had been massing their forces on the western bank of the Suez Canal for some time under conditions of great secrecy: men and equipment were moved up under cover of darkness and then carefully camouflaged and instructed to maintain strict radio silence. To the Israeli observers on the far bank things appeared perfectly normal, even down to Egyptian soldiers resting in the open. The Egyptian forces included the 2nd Army in the north with three infantry divisions (2nd, 16th and 18th) and the 3rd Army in the south with two infantry divisions (7th and 19th). In addition there were two armoured and three mechanized divisions plus additional brigades of tanks and paratroops, and battalions of commandos and marines. All of this was protected by a massive air-defence system incorporating radars, surface-to-air missiles and anti-aircraft guns. This defensive screen had been well exercised in the earlier 'War of Attrition', and was treated with respect by the Israeli air force.

The Israelis started to receive information from a number of sources of an impending Egyptian attack during September 1973, but they did not mobilize their reserve forces as previous alarms had proved to be false and the Israeli economy could not afford the expense of full mobilization every time there was a warning. When the Israelis discovered that the Soviet military advisers were being withdrawn from both Syria and Egypt they became more concerned, although as late as 5 October the overall intelligence picture presented to the general staff was that there was little probability of war breaking out; some Israelis were convinced, however, that an Egyptian attack was imminent.

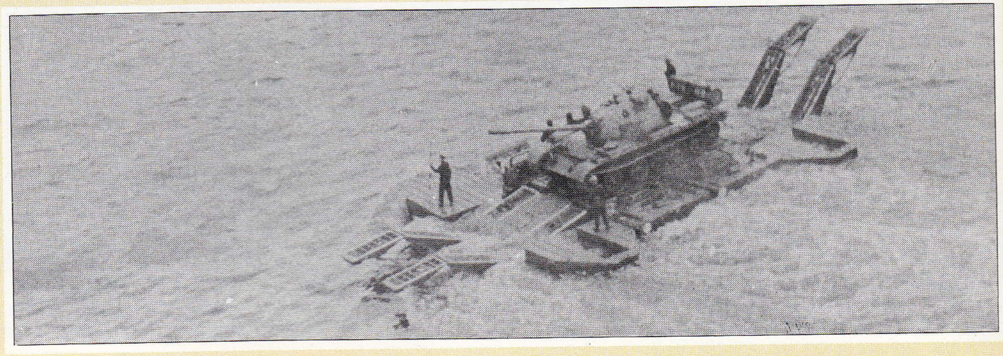
By the next day information had started to come in at an increasing rate, and Israel was certain that war would break out on both the Syrian (Northern) and Egyptian (Southern) Fronts during that afternoon.

In 1973 the Suez Canal was about 18 m (59 ft) deep and between 164 m (538 ft) and 220 m (722 ft) wide. The original bank on the Egyptian side was about 3 m (10 ft) high, but the Israelis had raised their side to anything up to 21 m (69 ft) in height to make it impossible for amphibious vehicles to cross the canal and then climb the banks. In addition to the fortifications along the canal, there were also prepared tank and artillery positions. When the Egyptians attacked on the afternoon of Saturday 6 October, there were less than 500 men and just three tanks defending the Bar-Lev Line.

Egyptian air strikes

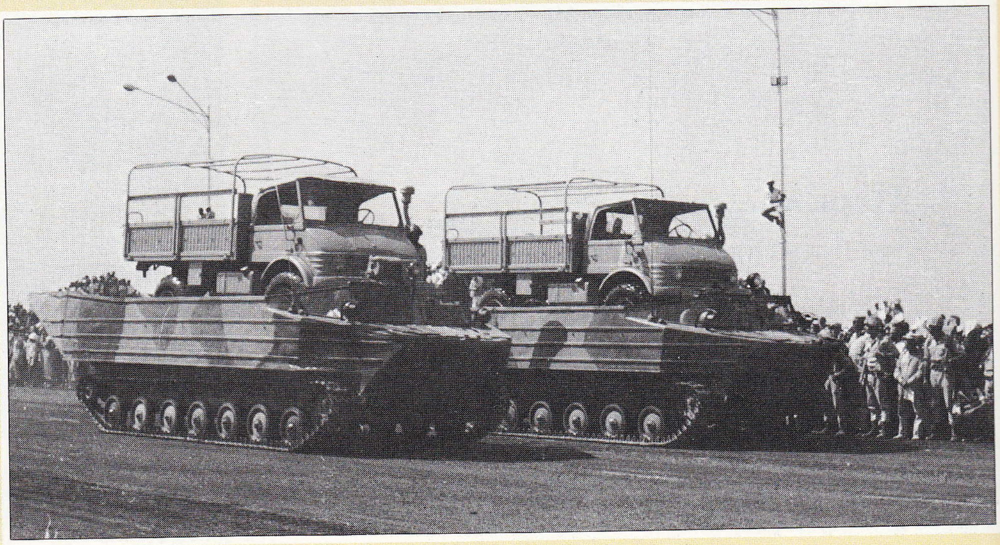
The Egyptian air force carried out some 250 sorties against the three key airfields in Sinai as well as against the major Israeli command, control and communications centres, some of the strongpoints on the canal itself, and air-defence and artillery positions. The Egyptian army opened up with some 2,000 artillery pieces, Soviet-supplied FROG surface-to-surface missiles and multiple rocket systems. The role of the first wave of 8,000 Egyptian infantrymen was to cross the canal in asssault boats, wherever possible well away from the Israeli fortifications and their machine-guns, and to hold the far bank until the arrival of the second wave of infantry, which was tasked to hold the bank while the first wave advanced a short distance ahead and dug in. Once the second and fourth waves were safely across they advanced about 2 km (1.24 miles) into the desert and dug in. Many of them brought with them the man-portable version of the Soviet AT-3 'Sagger' anti-tank guided weapon (commonly called the suitcase tank killer) as well as SA-7 'Grail' man-portable surface-to-air missiles.

The infantry bypassed the Israeli Bar-Lev strongpoints, which were left to specially trained units. The Egyptians had expected very heavy casualties in the first waves, but

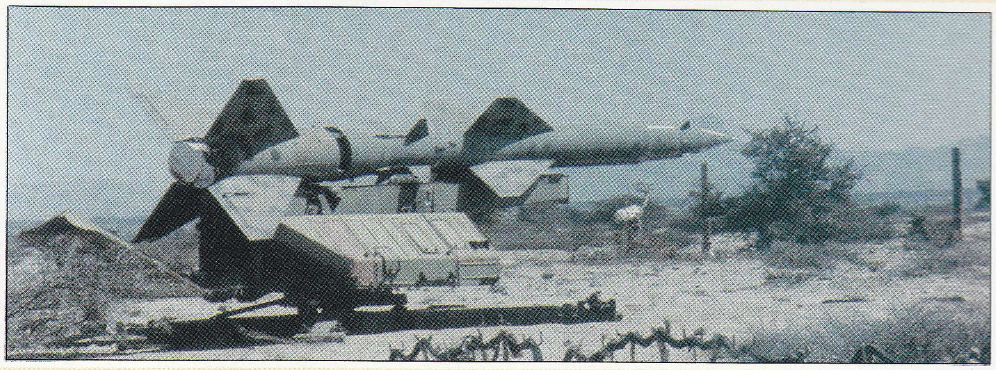


Above: Two GSP heavy amphibious ferry units coupled together carry a T-54 MBT. Each unit enters the water on its own and is then joined up to form the ferry, which can carry weapons or vehicles weighing a maximum of 52 tonnes (114,640 lb). Maximum water speed fully loaded is 7.7 km/h (4.8 mph).

Below: Soviet-supplied K-61 fully-tracked amphibious cargo carriers were used by the Egyptian army to carry troops, weapons and supplies across the Suez Canal. These vehicles are each carrying a West German Mercedes-Benz Unimog 4×4 light cargo truck.



their total losses were only about 200 men killed, many of these being in the 3rd Army to the south.



A Soviet-supplied SA-2 'Guideline' surface-to-air missile of Egyptian Air Defence Command. These missiles forced the Israeli air force to fly much lower, where they encountered anti-aircraft systems such as ZSU-23-4. When the Israeli army crossed the Suez Canal these were neutralized.

Ten bridges

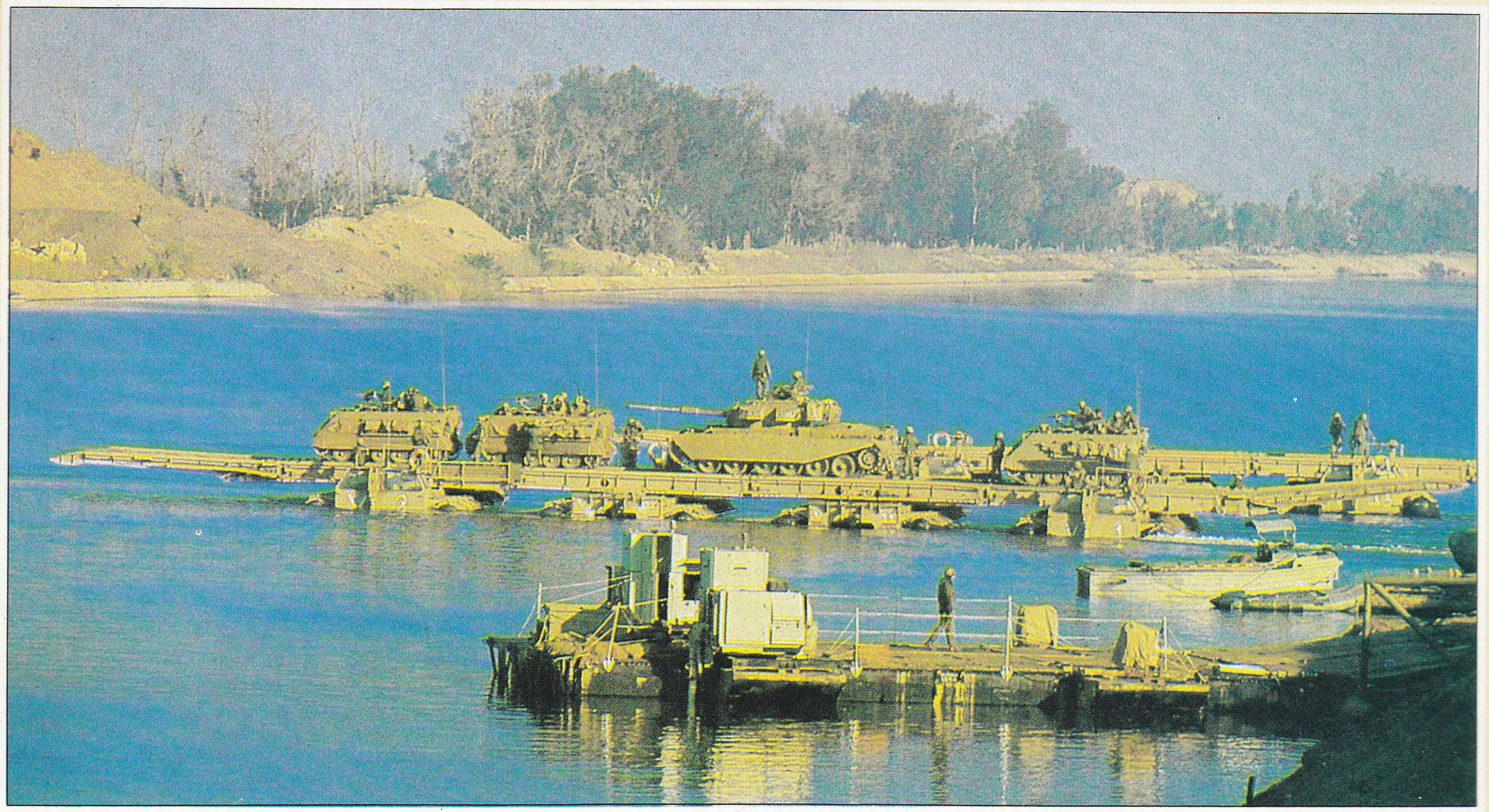
A total of 10 bridges was put across the Suez Canal: three near Kantara, three around Ismailia-Deversoir and the remaining four around Geneifa-Suez. The biggest problem facing the Egyptians was the rapid removal of the high banks of sand on each side of the canal so that vehicles could get to the pontoon bridges. The Israeli army had estimated that it would take anything from 24 to 48 hours for the Egyptians to put bridges across the canal, which would be enough time for the Israelis to bring their reinforcements up from the rear. The Egyptians solved this problem by using high-pressure water jets simply to wash the banks away. The Soviet-supplied 'ribbon bridges' were quickly in position and soon the tanks, armoured personnel carriers and other equipment was pouring across the Suez Canal. The Israeli army engaged the Egyptian crossing points with artillery, but this was not very accurate as a result of the lack of forward observers. The Israeli air force soon started to attack the bridges as well, but its aircraft encountered heavy anti-aircraft fire as the bridges were well within the protection belt of guns and missiles. When the Israelis did succeed in hitting and damaging one of the pontoon bridges, the Egyptians were able to take the damaged pontoon out and put in a new one. In addition to the 'ribbon bridge', Soviet-supplied GSP ferries were also used by the Egyptians to ferry armoured vehicles across the canal.

The objective of the Egyptian army was that each division was to establish a firm bridgehead about 8 km (5 miles) long and 5 km (3.1 miles) deep and then to push forward through the three key passes of Khatmia, Gidi and Mitla. The Egyptians hoped that by the evening of 7 October they would be on the Israeli supply road, but in fact by this time they held only three large pockets, although massive amounts of equipment were now on the east bank of the Suez Canal for the inland exploitation.

The first Israeli counterattacks were a disaster as tank after tank was hit by the well-concealed 'Sagger' ATGWs, and soon the battlefield was littered with burning Israeli tanks. The world's media, on hearing of the first unsuccessful Israeli counterattacks, believed that this proved that the tank had no future. The Israelis had in fact stumbled ahead without artillery, infantry or air support and consequently paid a heavy price.

Soon, however, Israeli reinforcements started to reach the Southern Front, although to the general staff the situation on the Northern Front was far more serious as the Syrians had almost reached the Sea of Galilee. The reinforcements arrived in the nick of time, as by Sunday Mandler's division had lost two-thirds of its tanks. The rest is history: the Egyptians were stopped way before they reached to the crucial passes, and in the ensuing days the largest tank battles since the Battle of Kursk in World War II took place as 2,000 Israeli and Egyptian tanks slogged it out across the desert. The Israeli general staff had decided that the only way to defeat the Egyptian army was to attack across the canal itself, and chose a spot north of the Great Bitter Lakes between the Egyptian 2nd and 3rd Armies. Once the bridgehead was established across the canal, units swept north to Ismailia and westward where they not only engaged the Egyptian army but also knocked out the SAM sites that were proving so much trouble to the Israeli air force. In the end the Egyptian 2nd Army was cut off and a ceasefire came into effect on 22 October.

Below: After the Egyptians failed to reach the passes, the Israelis counterattacked and themselves crossed the canal just north of the Great Bitter Lakes. The subsequent armoured drive to Ismailia broke the Egyptian defence and ended the war.



SWEDEN

FFV Anti-Tank Mines

Anti-tank mines have been around since the tank first appeared on the battlefield. Until recent years these normally had a pressure-type fuse that was activated by the tracks of the tank and relied on the blast effect to cause damage to it. Combat experience has shown that in many cases the suspension of the tank is damaged, so resulting in a mobility kill. But often the tank can be repaired and soon be in service again. With pressure-type anti-tank mines large numbers of mines have to be laid to ensure that the minefield is effective.

FFV of Sweden realized that what was required was an anti-tank mine that would kill the tank rather than immobilize it for a few hours, and that the introduction of new fuses would not only make the mine more effective but also reduce the number required. This mine was given the designation **FFV 028**, and after the usual troop trials and modifications was accepted for service with the Swedish army in 1982.

The FFV 028 anti-tank mine can be laid by hand but is normally laid by a two-wheeled minelayer specially developed by FFV. This minelayer can be towed by a variety of tracked and wheeled vehicles, and can lay the mines on the surface or under the ground at a maximum rate of 20 a minute; the operator can select the distance between each so minefields with various densities can be laid. The buried mines are laid about 250 mm (9.84 in) under the ground and the top soil is replaced, so making detection difficult by the naked eye.

There are two main parts to the FFV 028 anti-tank mine: the fuse system in the centre and the body itself, which contains the battery, uncovering charge, liner and main charge. Once the mine is laid it operates as follows. When a vehicle passes over the mine the fuse system senses the disturbance in the local magnetic field, and when the conditions are right (i.e. the vehicle is right over the mine) the electronic unit emits an initiation pulse to the electronic detonator. This sets off the uncovering charge, which not only blows away the upper part of the centre of the mine but also the earth or any camouflage over the mine. The hollow charge then goes off, and this will penetrate the belly armour of any tank, showering the inside of the vehicle with fragments of metal and also probably setting off the ammunition that is often stowed in the lower part of the tank.

Two types of the FFV 028 have so far been developed: the standard **FFV 028 RU** and the more sophisticated **FFV 028 SN**. The latter is fitted with booby-trap and self-destruction/neutralization devices, and has an operational life of 30 days.

According to FFV, a conventional minefield with 1,000 anti-tank mines can be laid by 30 soldiers in about 3.5 hours, whereas the FFV minelayer can in 1 hour lay 400 mines with the same effectiveness using just four men.

FFV has also recently developed another mine system, the **FFV 013** anti-personnel mine. This shrapnel-type weapon can be used not only for ambush purposes but also for defending key airfields and other vulnerable targets. When activated the mine projects 1,200 fragments to a range of 150 m (164 yards) through an arc of 100 m (328 ft) to a height of 4 m (13 ft).

Specification

FFV 028 RU

Type: anti-tank mine

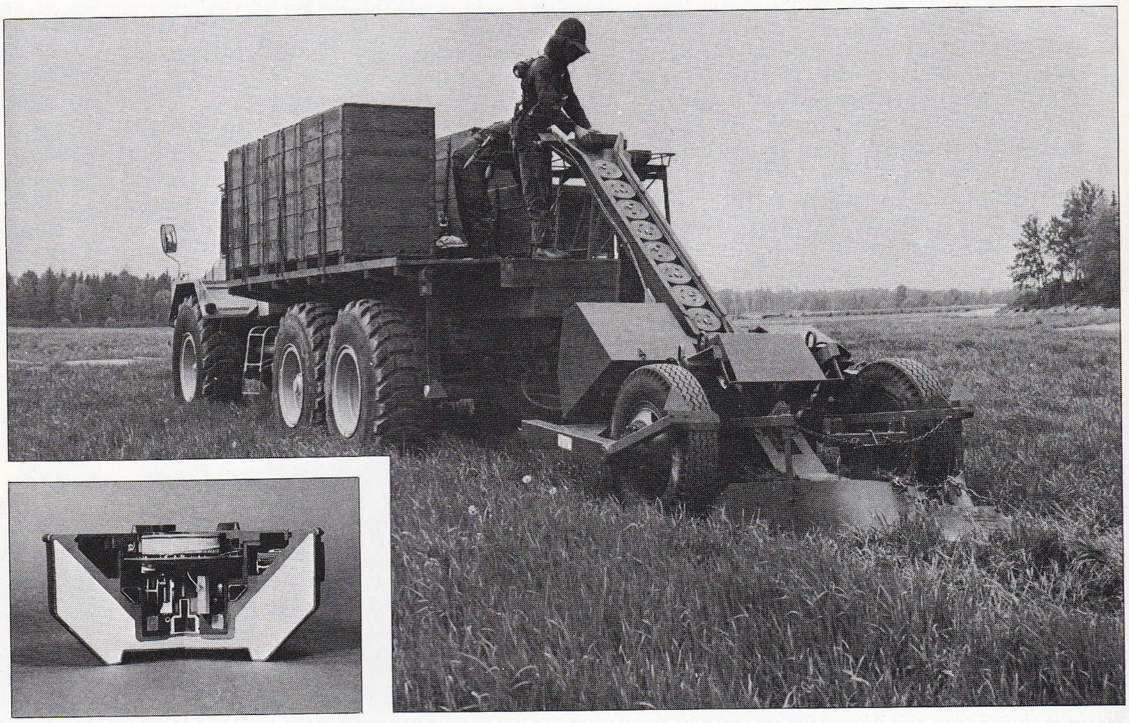
Weight: whole weapon 7.5 kg (16.53 lb); bursting charge 3.5 kg (7.7 lb)

Dimensions: diameter 250 mm (9.8 in); height 110 mm (4.3 in)

Bursting charge: RDX/TNT

Operational life: 180 days

Below: A Swedish FFV mechanical minelayer is towed by a Volvo All Terrain Vehicle with FFV 028 anti-tank mines being placed on a minelaying chute. Inset: A cutaway of the mine itself. One version has an operational life of 120 days; the other has a self-neutralization system which operates after 30 days.



USA

Family of Scatterable Mines

Of all the nations in the world it is the United States that has put the most effort into the design, development and production of new mine systems, which have been given the official title **Family of Scatterable Mines**, or **FASCAM** for short.

ADAM

The **Area Denial Artillery Munition (ADAM)** is already in service with the US Army and is fired from 155-mm (6.1-in) artillery weapons such as the self-propelled M109. There are two types of ADAM projectile, each containing 36 mines: the **M692** projectile has mines with a long self-destruct fuse (i.e. more than a day), while the **M731** has mines with a short self-destruct fuse (i.e. less than a day). The mines carried by ADAM are wedge-shaped and lie on the surface; each mine has seven trip wires, and once any one of these is touched it activates the mine which explodes sending out hundreds of fragments.

RAAMS

The **Remote Anti-Armor Mine System (RAAMS)** is similar in concept to ADAM except that it carries anti-tank mines each weighing 2.27 kg (5 lb): the **M718** projectile carries mines with long self-destruct time (i.e. over 24 hours), while the **M741** projectile carries mines with a short self-destruct time (i.e. under 24 hours). The actual projectile case of both ADAM and RAAMS is the same as that used in the **M483 Improved Conventional Munition (ICM)**, which has 88 grenades that are dispensed over the target area. In operational use an artillery battery would probably fire several volleys of both ADAM and RAAMS projectiles to give a combined anti-tank and anti-personnel minefield.

M56 anti-tank mine system

The **M56** was the first member of the FASCAM series to enter service with the US Army. The M56 system consists essentially of a Bell UH-1 series helicopter with a SUU-13/A dispenser on each side of the fuselage and a control panel inside. Each dispenser holds 40 canisters, each of which has two M56 anti-tank mines. There are three different types of mine, all of which lie on the surface and are identical in appearance: the first is operated by a pressure fuse; the second has been designed to defeat minefield clearing by rollers and will detonate after the rollers have passed overhead; and the third has an anti-disturbance device to discourage clearance efforts. The M56 entered service in 1977 and will probably be replaced in the future by the Volcano universal mine-dispensing system.

GEMSS

The **Ground Emplaced Mine Scattering System (GEMSS)** is one of the more recent members of FASCAM, and is more commonly known as the **'Frisbee Flinger'**. It consists basically of a trailer that can be towed by a wheeled (e.g. 6×6 truck) or tracked vehicle (e.g. M113 APC) on which is mounted a large drum-type magazine that can dispense **M74** anti-personnel mines and **M75** anti-tank mines at the rate of two per second; 800 mines can be carried. Once the 800 mines have been surface-laid, the launcher can be reloaded by five men in about 20 minutes.

Volcano

The **Volcano** universal mine-dispensing system is being developed to meet the requirements of the US Army and will be carried on the sides of the Sikorsky UH-60 Black Hawk helicopter as well as by vehicles such as trucks. Each UH-60 will have two dispensers each holding 40 canisters of mines on each side of the fuselage; 960 anti-tank and anti-personnel mines will be carried for dispensing in sequence over the target area.

MOPMS

The **Modular Pack Mine System (MOPMS)** consists of a module that can be carried by two men and contains 21 anti-tank and anti-personnel mines which are launched by a remote control unit.

GATOR

The anti-armour system known as **GATOR** was developed for use by the US Navy and US Air Force, and consists of dispensers which are carried under an aircraft to distribute anti-tank mines.

Mine Warfare

Modern landmines are a deadlier menace than ever before. Now largely made of plastic, they are difficult to detect and are often fitted with anti-handling devices to blow up anyone attempting to disarm them. Laid rather like seeds by machines towed by APCs, mines threaten men and vehicles alike, and the search for effective countermeasures continues.

Mine warfare today involves not only the laying of anti-tank and anti-personnel mines, but also their detection and clearance. As mines have become more sophisticated a great deal of work has gone into detection and clearance methods.

Mine detection

For many years most anti-tank and anti-personnel mines had a large metal content (including the case and fuse). This made their detection by conventional mine detectors a fairly easy matter. Then, during World War II, mines made of wood, cardboard and even glass were introduced, these proving very difficult to detect, and in recent years most of the new mines introduced into service are made of plastic with just one or two small metal parts in their fuses. This has made their location by conventional devices almost impossible, so considerably more sensitive mine detectors have now been developed and placed in service.

A typical modern mine detector is the NMD-78 supplied by United Scientific Instruments of the UK. This system can detect metal and non-metallic mines in almost every type of soil. Soil conditions can also cause problems in mine detection so the NMD-78 automatically takes this factor into account. The operator normally walks slowly ahead sweeping the mine detector from one side to the other. If a mine is detected a signal is given in the headphones worn by the operator, who then stops. He then carefully examines the surface to see if there are any tell-tale marks: for example, fresh earth can indicate that a mine has just been laid, while a trip wire can warn of an anti-personnel mine or a tilt rod of an anti-tank mine. The operator then has to call in a specialized mine-clearance team with its equipment to uncover the mine very carefully and try to disarm it. Many mines have an anti-lift device (detonating the weapon as soon as it is lifted out of the ground), while others have a built-in anti-disturbance system.

Mines used by terrorists are virtually impossible to detect as they can take almost any form, for example a milk churn left alongside a road in a country area. In Northern Ireland terrorists often pack as much as 227 kg (500 lb) of high explosive in a culvert or drain under a road to be detonated by remote control as a police or army vehicle passes. These mines have so much force that any vehicle above, even an armoured personnel carrier, will be destroyed. Dogs have proved to be very useful in sniffing out both mines and explosives in many countries, and the USA is currently working on the Airborne Minefield Detection System (AMIDS), which will be an RPV fitted with electro-optical sensors.

Mine clearance

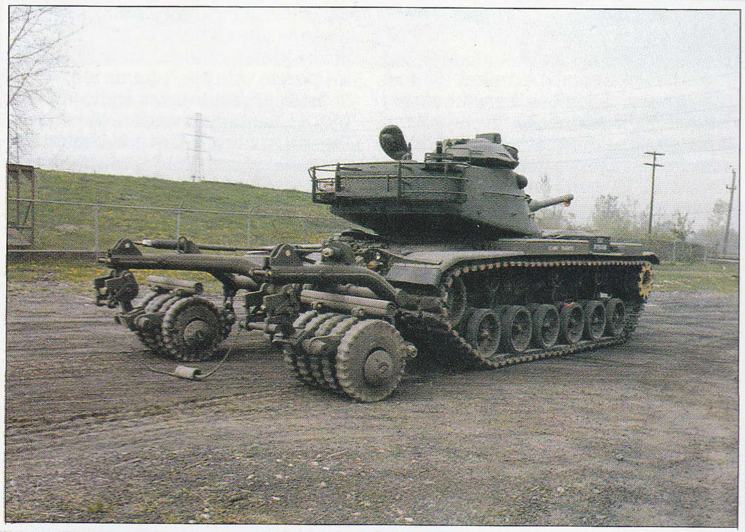
Once mines have been detected they must be cleared, or a way has to be found around the minefield. Mines can be cleared by hand, but this is a time-consuming and dangerous occupation. There are now a number of systems that can be employed to clear both anti-tank and anti-personnel minefields, although none of them is 100 per cent effective.

For many years the Soviet Union has fitted some of its T-54/T-55 tanks with mine-clearing rollers to the front of each track: the tank is driven forward and the rollers have sufficient pressure to set off any anti-tank mines in their path. The explosion caused by the mine lifts the rollers into the air, hopefully not damaging all of them. The US Army has recently issued a mine-clearing roller for its M60 series tanks. Another system is the mine plough, which is attached to the front of the tank which is then driven forwards; mines in its path are then pushed aside for later neutralization or detonation. The Israeli and British armies both have mine-clearance ploughs in service; in the latter army they are fitted to Centurion AVREs and Chieftain bridgelayers.

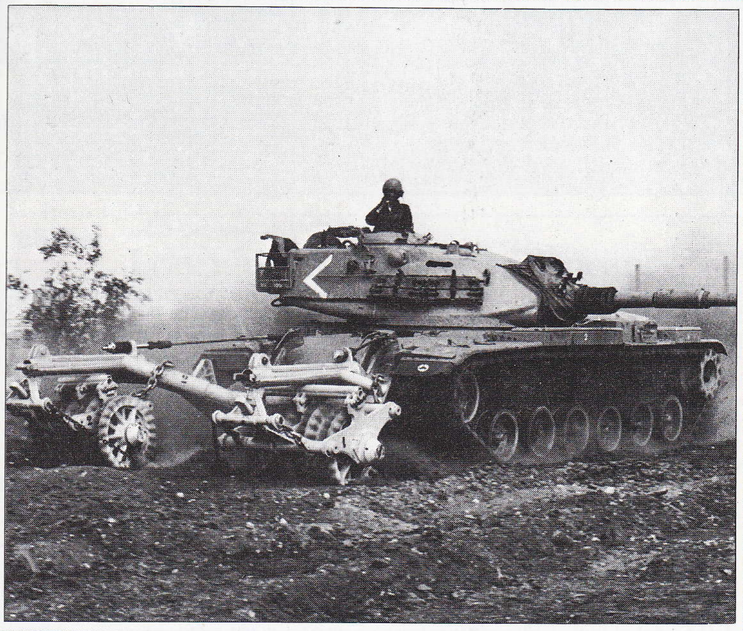
Yet another system is an explosive charge such as the British Giant Viper system or the Soviet MTK. The former is trailer-mounted and normally towed by a Centurion AVRE. The vehicle halts just outside the minefield and the Giant Viper is fired from within the safety of the vehicle: a 229-m (750-ft) hose filled with explosive is carried across the minefield by a cluster of eight rockets, and falls (hopefully in a straight line) onto the minefield before being detonated to clear a path 182 (600 ft) long and 7.6 m (25 ft) wide.

The US Army has also tried using Fuel Air Explosives for clearing minefields and trials have been quite successful. One system, the Surface-Launched Unit, Fuel Air Explosive (SLUFAE), and based on an M548 tracked cargo carrier, may well enter service in the not too distant future.

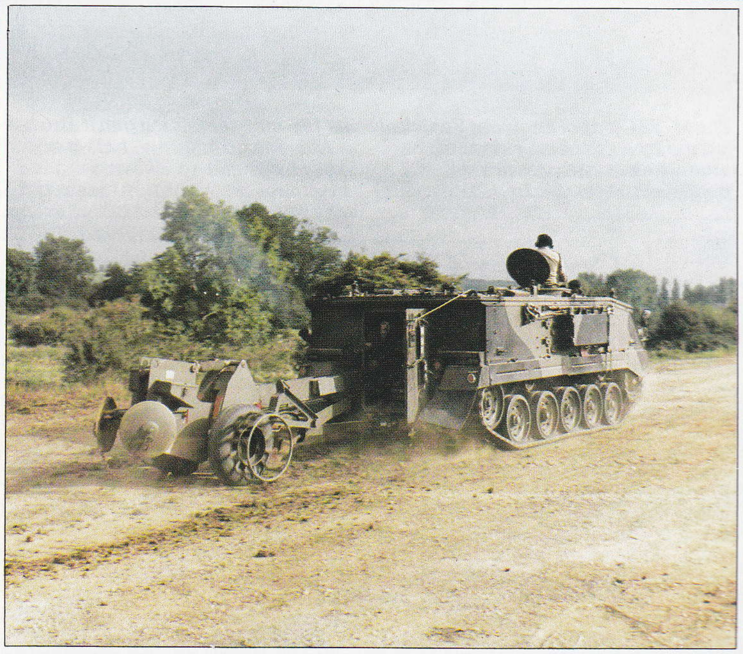
As the British army discovered in the Falklands conflict and the US Army in Vietnam, mines are a major problem and at present there are no systems that can detect and clear every type of mine likely to be encountered.



The front-mounted mine-clearing roller system fitted to this M60A3 detonates mines before the tank runs over them. The device between the rollers sets off mines with tilt rod fuses.



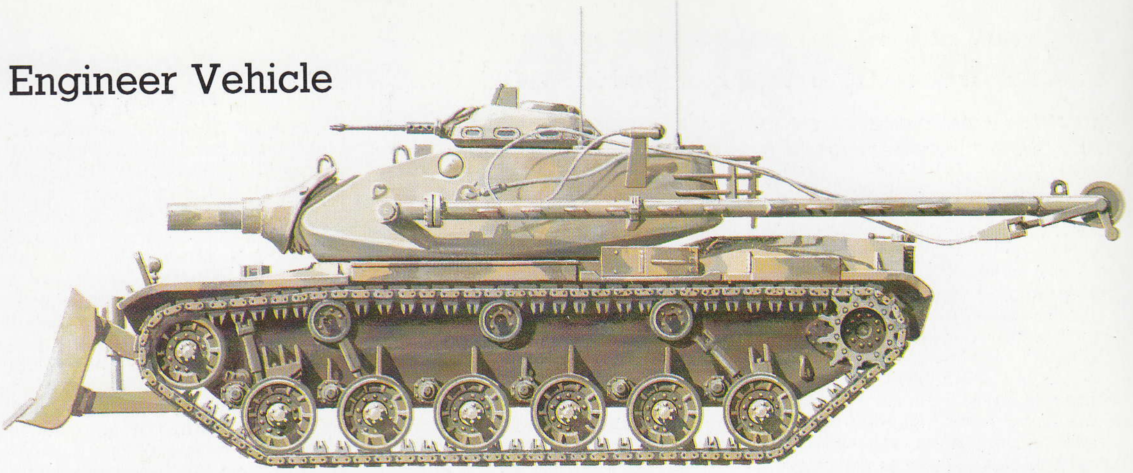
This M60A1 MBT of the Israeli Army is fitted with RKM mine-clearing rollers on the hull front. These are essentially an adaptation of the Soviet RKM mine-clearing rollers, and can be mounted by two men in about 15 minutes provided that the tank has already been fitted with an adaptor assembly.



An FV432 armoured personnel carrier of the British Army tows a Royal Ordnance Bar minelayer. Bar mines are placed on the chute of the minelayer, which arms the mine, buries it and replaces the soil to make detection of the mines more difficult.

USA

M728 Combat Engineer Vehicle



The standard combat engineer vehicle of the US Army is the M728, which is a M60 tank with its 105-mm gun replaced by a 165-mm demolition gun, an A-frame for lifting pivoted at the front of hull and a hydraulically-operated dozer blade for clearing obstacles. It is also used by Singapore and Saudi Arabia.

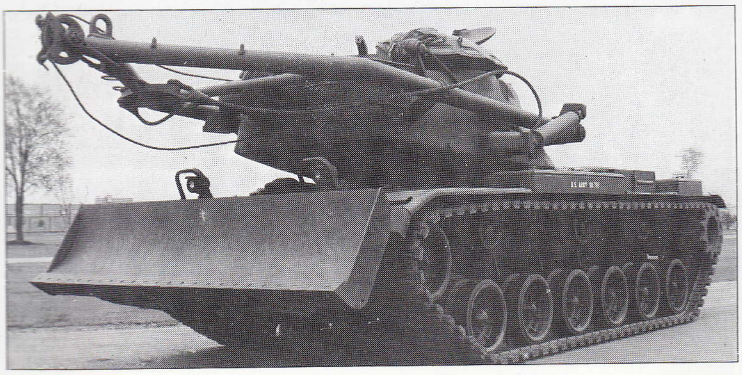
In the 1950s the standard MBT of the US Army was the M48, which was to have been replaced by a new vehicle called the T95. Using the same chassis a combat engineer vehicle was developed under the designation T118. In the end the whole T95 project was cancelled along with the T118, and further development of the M48 took place. The result was the M60, which entered production in 1960. A decision was then taken to develop a combat engineer vehicle on this chassis under the designation **T118E1**. After trials with prototype vehicles, this type was finally accepted for service as the M728 Combat Engineer Vehicle in 1963. So far some 300 M728s have been built at the Detroit Tank Plant, which is now operated for the US Army by General Dynamics. In addition to being used by the US Army the M728 is also in service with Saudi Arabia and Singapore.

The M728 is essentially an M60A1 MBT with its 105-mm (4.13-in) M68 gun replaced by a short-barrelled 165-mm (6.5-in) demolition gun for neutralizing battlefield fortifications; 30 rounds of high explosive squash-head (HESH) ammunition are carried for this gun. A 7.62-mm (0.3-in) machine-gun is mounted co-axial with the main armament, and the commander has a cupola-mounted 12.7-mm (0.5-in) machine-gun.

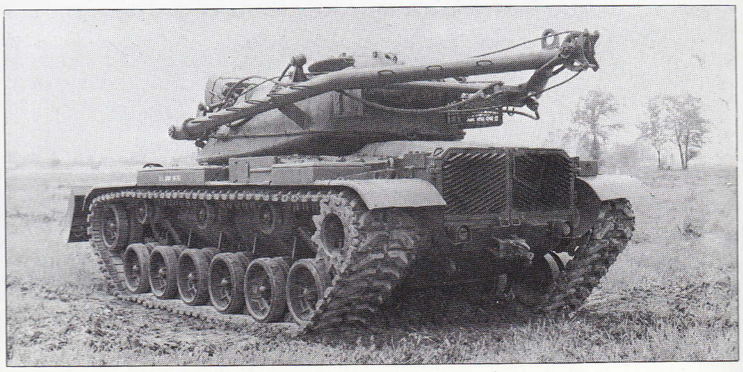
Pivoted at the front of the hull is an A-frame which can lift a maximum load of 15876 kg (35,000 lb); when the vehicle is travelling the A-frame is normally swung through about 120° to lie back on the rear engine decking. The winch to operate with the A-frame is mounted at the rear of the turret and controlled by the tank commander. Mounted at the front of the hull is a hydraulically-operated dozer blade which can be used for filling in holes, clearing obstacles and preparing fire positions. Standard equipment on all vehicles includes night-vision equipment (including a searchlight mounted above the main armament), an NBC system and provision for installing deep fording apparatus.

For some 20 years the US Army has been developing a vehicle called the **Universal Engineer Tractor** (or **UET**). This was subsequently renamed the **M9 Tractor, Full Tracked, High Speed, Armored Dozer-Scraper Combination**, and more recently still the **M9 High Speed Armored Combat Earth Mover**, or **ACE** for short. Each year the US Army has requested funding for this vehicle so that full-scale production can start, but each time the Congress has turned the request down. The M9 is a highly flexible piece of equipment, and can be used as a dozer, grader, scraper, dumper, pioneer vehicle or carrier. It can be transported by aircraft or helicopters such as the Sikorsky CH-54, and has a limited amphibious capability.

Specification
M728
Crew: 4
Weight: 53200 kg (117,285 lb)
Powerplant: one Teledyne Continental AVDS-1790-2A 12-cylinder diesel developing 559.3 kW (750 bhp)
Dimensions: length (travelling) 8.92 m (29 ft 3 in); width (overall) 3.71 m (12 ft 2 in); height (travelling) 3.20 m (10 ft 6 in)
Performance: maximum road speed 48.3 km/h (30 mph); maximum range 451 km (280 miles); fording 1.22 m (4 ft 0 in); gradient 60 per cent; vertical obstacle 0.76 m (2 ft 6 in); trench 2.51 m (8 ft 3 in)



The M728 Combat Engineer Vehicle is used by engineers in forward areas to clear and prepare battlefield obstacles. In addition to its 165-mm demolition gun it also has a 7.62-mm co-axial machine-gun and a cupola-mounted 12.7-mm machine-gun.



This M728 Combat Engineer Vehicle (CEV) has an A-frame lowered over the rear engine decks for travel. When required for use the A-frame is swung forwards through about 120 degrees and can lift a maximum load of 15876 kg (35,000 lb).

USA

Counter Obstacle Vehicle

At present the M728 Combat Engineer Vehicle is the standard vehicle of its type in the US Army. Although excellent for neutralizing battlefield fortifications, this type has very limited earthmoving capabilities and none at all for clearing mines. The Belvoir Research and Development Center near Washington, DC, has designed the **Counter Obstacle Vehicle (COV)** to carry out on the battlefield a wide range of roles such as mine clearance, the filling of anti-tank ditches and craters, and the removal of trees. The BMY company, which currently manufactures the **M88A1 Armored Recovery Vehicle** and a complete family of self-propelled artillery weapons, has built two COVs, which were completed early in 1985. One of these is for the US Army and the other for Israel.

The prototypes are based on a modified M88A1 with a much more powerful engine. The driver, telescopic arms' operator and vehicle commander are seated one behind the other at the front of the vehicle: each crew member has a rearward-opening hatch cover and observation periscopes, and is seated slightly higher than the man in front to allow good observation of the terrain.

Mounted at the front of the hull is the hydraulically-controlled dozer blade, which is also used to clear mines by pushing them to one side. Mounted above the blade are three sensor arms which control the operating height of the blade automatically.

Pivoted at the front of the hull, one on each side, are two telescopic arms each fitted with a digging bucket. When travelling, the arms are retracted and traversed to the rear to reduce the COV's overall length. If required, the bucket at the end of each telescopic arm can be replaced by other attachments such as an auger for boring holes in the ground, grapples, lifting hooks, clamshells and hammers. Another useful feature of the two arms is that they can also be used to assist the vehicle in getting itself out of obstacles. Mounted at the front and rear are hydraulic outlets for a variety of hand tools.

If required the COV could also be fitted with mine-clearing rollers at the front of the hull, and a Clear Lane Marking System (CLAMS) at the rear to show following vehicles the clear path.

If trials with the prototype of the COV are satisfactory, production is expected to start later this decade if money is made available by the Congress.

Specification (provisional)
COV
Crew: 3
Weight: loaded 61779 kg (136,200 lb)
Powerplant: one Teledyne Continental Motors AVDS-1790-5 V-12 diesel developing 677.1 kW (908 hp)
Dimensions: length (overall) 11.48 m (37 ft 8 in); width (vehicle only) 3.43 m (11 ft 3 in); height 2.87 m (9 ft 5 in)
Performance: maximum road speed 43.5 km/h (27 mph); maximum road range 402 km (250 miles); fording 1.42 m (4 ft 8 in); gradient 60 per cent; vertical obstacle 1.07 m (3 ft 6 in); trench 2.62 m (8 ft 7 in)

WEST GERMANY

M2 Amphibious Bridge and Ferry System

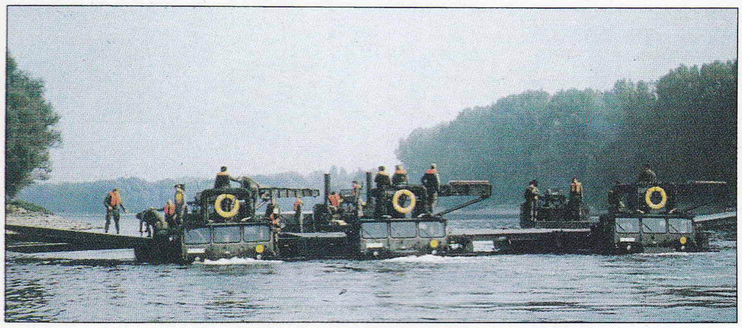
In the 1950s the West German company Eisenwerke Kaiserslautern Göppner GmbH undertook production of the **Gillois bridge and ferry system** based on the design of the French General J. Gillois. The Gillois system, which is still used by the French army, consists of two basic units, bridge and ramp: each of these is mounted on a 4×4 vehicle fitted with large 18×25 cross-country tyres and powered by a 164.1-kW (220-hp) V-12 Deutz diesel engine. Before the equipment enters the water a pneumatic float is attached on each side and inflated to provide additional buoyancy. When the units are in the water the roadway or ramp units are rotated through 90° and coupled up to form a bridge or ferry. When afloat each unit is propelled by a propeller unit. The major disadvantage of this system is that it takes almost 30 minutes to prepare each unit for water use and the pneumatic floats are prone to damage, not only from small arms fire and shell splinters but from river debris.In the 1960s EWK and Klockner-Humboldt-Deutz developed the **M2 Amphibious Bridge and Ferry System** to meet the requirements of the West German army. After the usual troop trials this was accepted and entered service in 1968. The M2 system is also used by the British army and Singapore, the latter having a version with slightly more powerful engines.

The M2 is based on a 4×4 chassis with 16.00×20 cross-country tyres; steering can be on all four wheels, and the ground clearance can be adjusted from within the cabin to suit the ground being crossed. Before the M2 enters the water, a hydraulically-operated buoyancy tank is unfolded on each side of the hull and the decking positioned by an onboard crane. This gives a total roadway length of 7.62 m (25 ft) and a width of 5.486 m (18 ft 0 in). The units then enter the water, where they are coupled together to form a ferry or bridge. The latter is to Class 50, although introduction of the Challenger MBT has meant that British army M2s have had to be beefed up to take the additional weight.

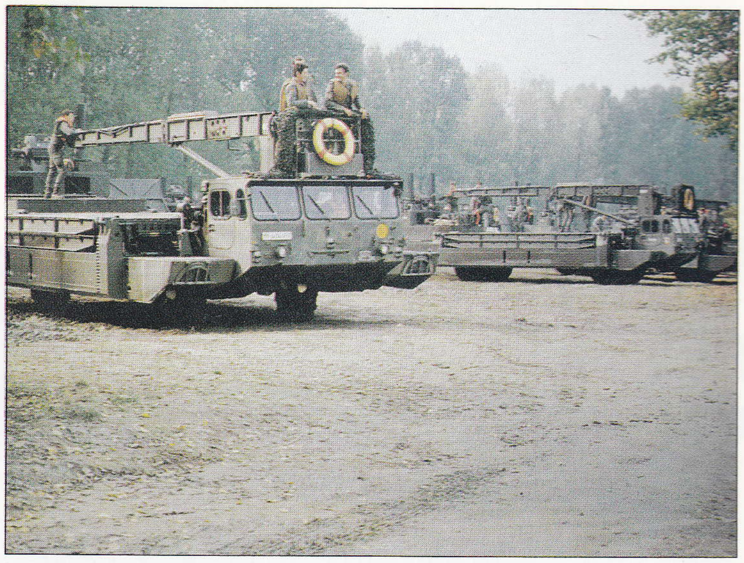
The M2 has two engines. When afloat one of these drives two propellers for lateral propulsion while the other powers a single steering propeller. The main advantage of the M2 over the earlier Gillois system is that it can be brought into action more quickly and is less susceptible to damage.

The Japanese Ground Self-Defense Force uses a system similar to the M2: this is called the **Type 70 Self-Propelled Pontoon Bridge** but has a capacity of 40000 kg (88,185 lb).

Specification
M2
Crew: 4
Weight: 22000 kg (48,502 lb)
Powerplant: two Deutz Model F 8 L 714a V-8 diesels each developing 132.7 kW (178 hp)
Dimensions: length (travelling) 11.315 m (37 ft 1.5 in); width (travelling) 3.579 m (11 ft 8.9 in); height (travelling) 3.579 m (11 ft 8.9 in)
Performance: maximum road speed 60 km/h (37.3 mph); maximum range 1000 km (621 miles); endurance (water) 6 hours; fording amphibious; gradient 60 per cent; trench no capability



Below: Three M2 amphibious bridging and ferry units are coupled together in the water to form three-bay ferry capable of carrying tanks such as the Leopard 2 or Chieftain. It is also used by Singapore and England.



An M2 amphibious bridging and ferry system with its hydraulically-operated buoyancy tanks in position each side of the hull prepares to enter the water. Each M2 has three propellers, one for steering and two for sideways propulsion. Maximum water speed is 14 km/h (8.7 mph).

Above: The introduction into British Army service of the Challenger MBT has meant that British M2 systems have had to be modified to carry the additional weight of these vehicles. This has been accomplished by the fitting of inflatable bags along the sides.

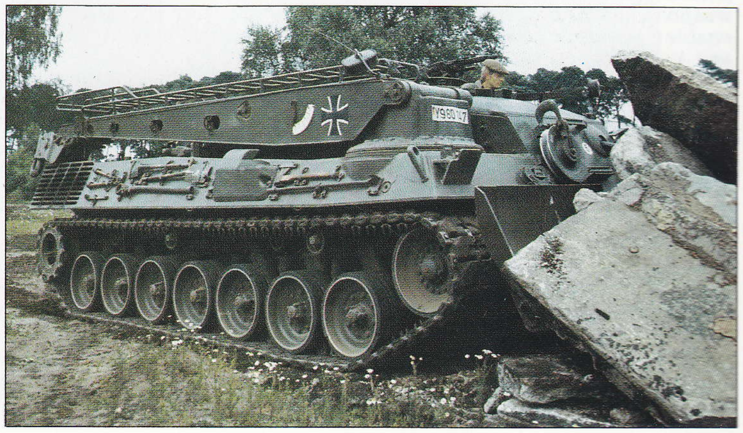
WEST GERMANY

Leopard 1 Armoured Engineer Vehicle

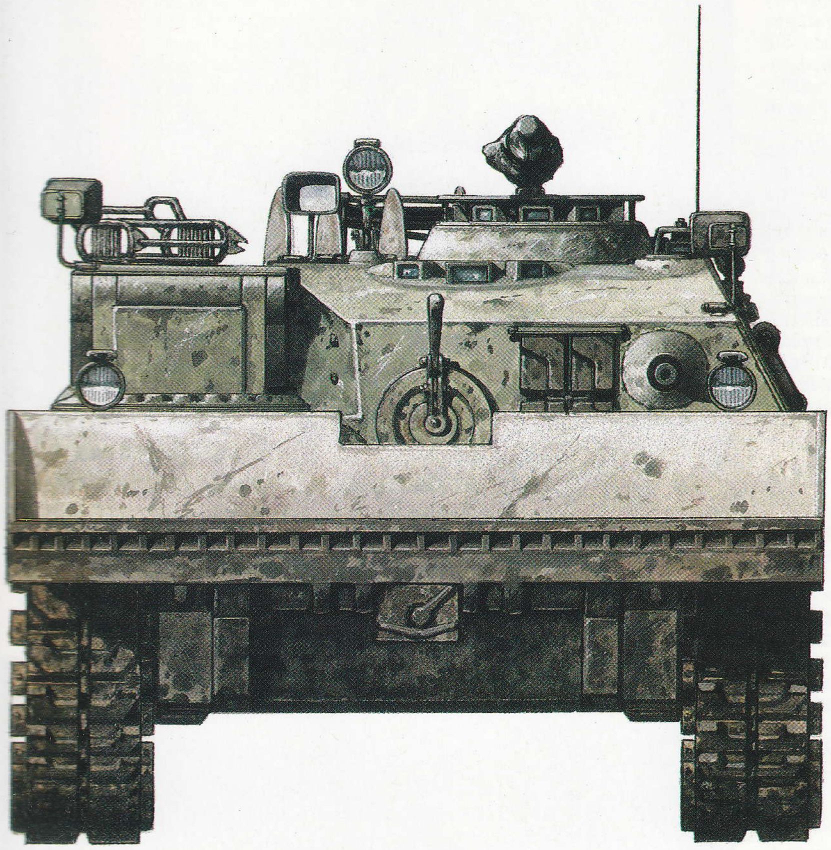
The **Leopard 1 Armoured Engineer Vehicle** was developed by Krupp MaK of Kiel specifically to meet the requirements of the West German army, the first production vehicles being completed in 1968. The company subsequently built six for Belgium, 36 for West Germany, 12 for Italy and 25 for the Netherlands. More recently OTO Melara of Italy has built an additional 28 Leopard 1 AEVs for the Italian army.

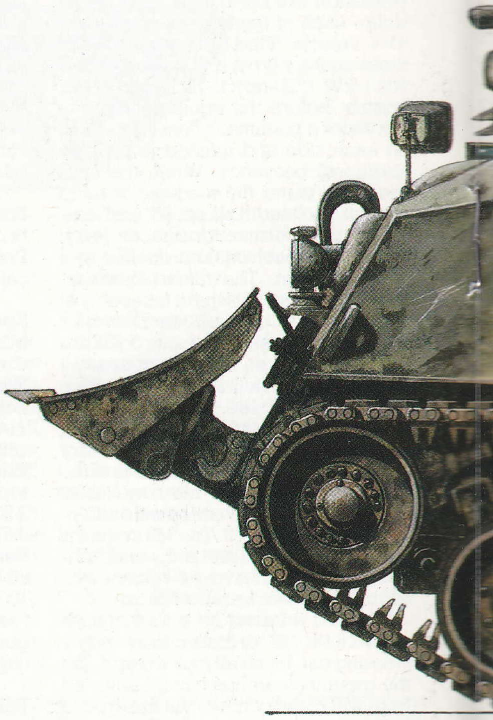
The Leopard 1 AEV is almost identical to the Leopard 1 Armoured Recovery Vehicle, the major difference being that the AEV carries demolition charges and fuses but has no spare powerpack.

Mounted at the front of the hull is a hydraulically-operated dozer blade that can be used for preparing fire positions, or for clearing roads and other obstacles. The width of the blade can be extended by adding pieces to each end and four scarifiers can be fitted to it for ripping up the surface of roads when the tank is being driven in reverse. The dozer blade is also used to stabilize the vehicle when the winch or crane is being used.



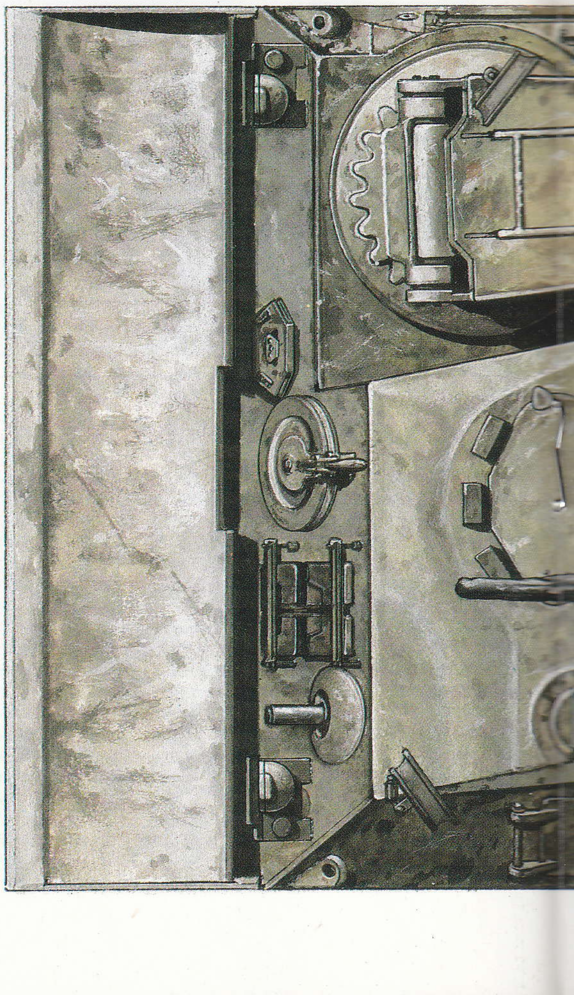
The Leopard armoured engineer vehicle is identical to the Leopard armoured recovery vehicle, except that it carries no powerpack and is fitted with a heat exchanger and auger, and its dozer blade is fitted with special scarifiers to rip up the surfaces of roads.

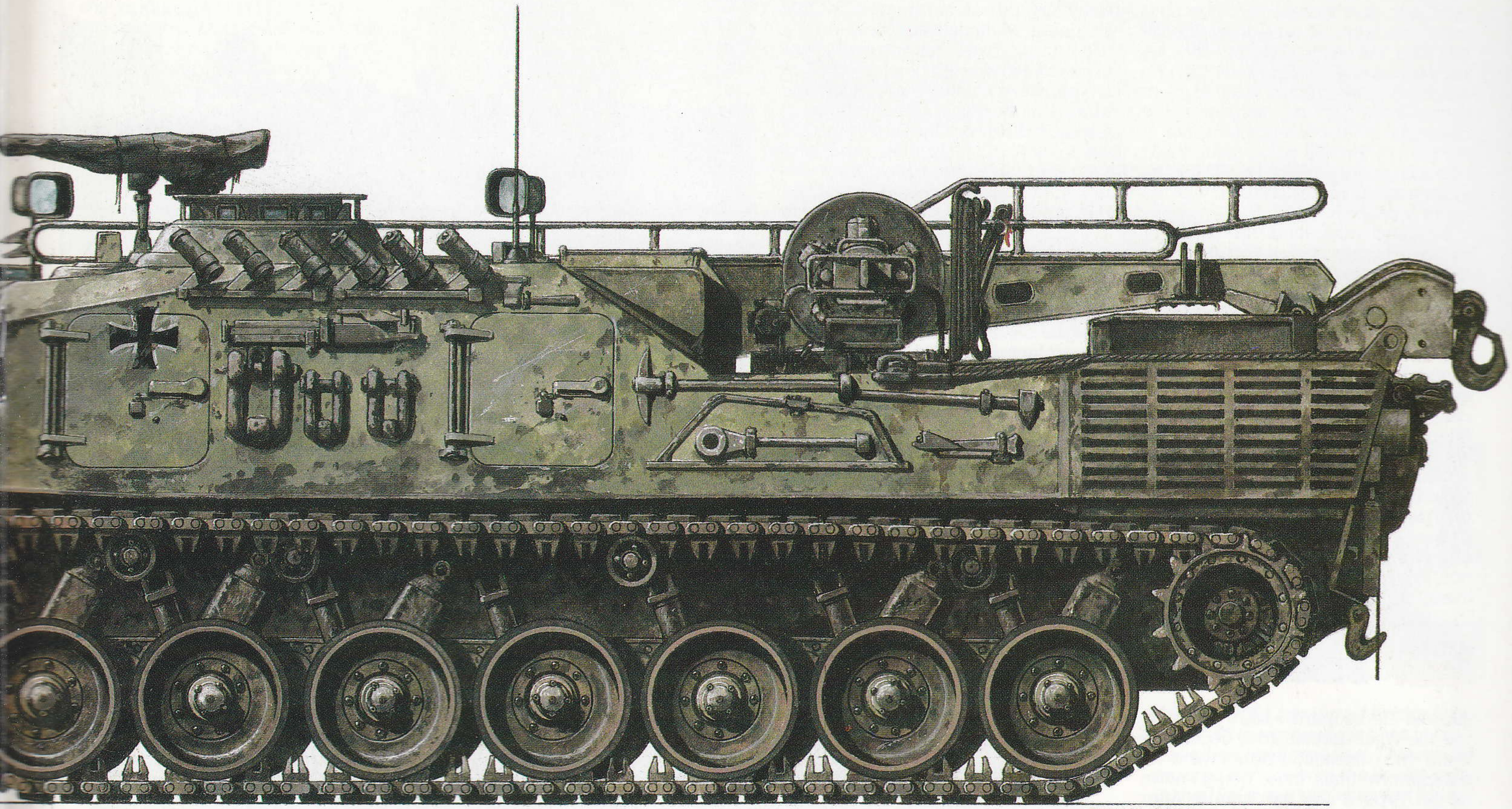


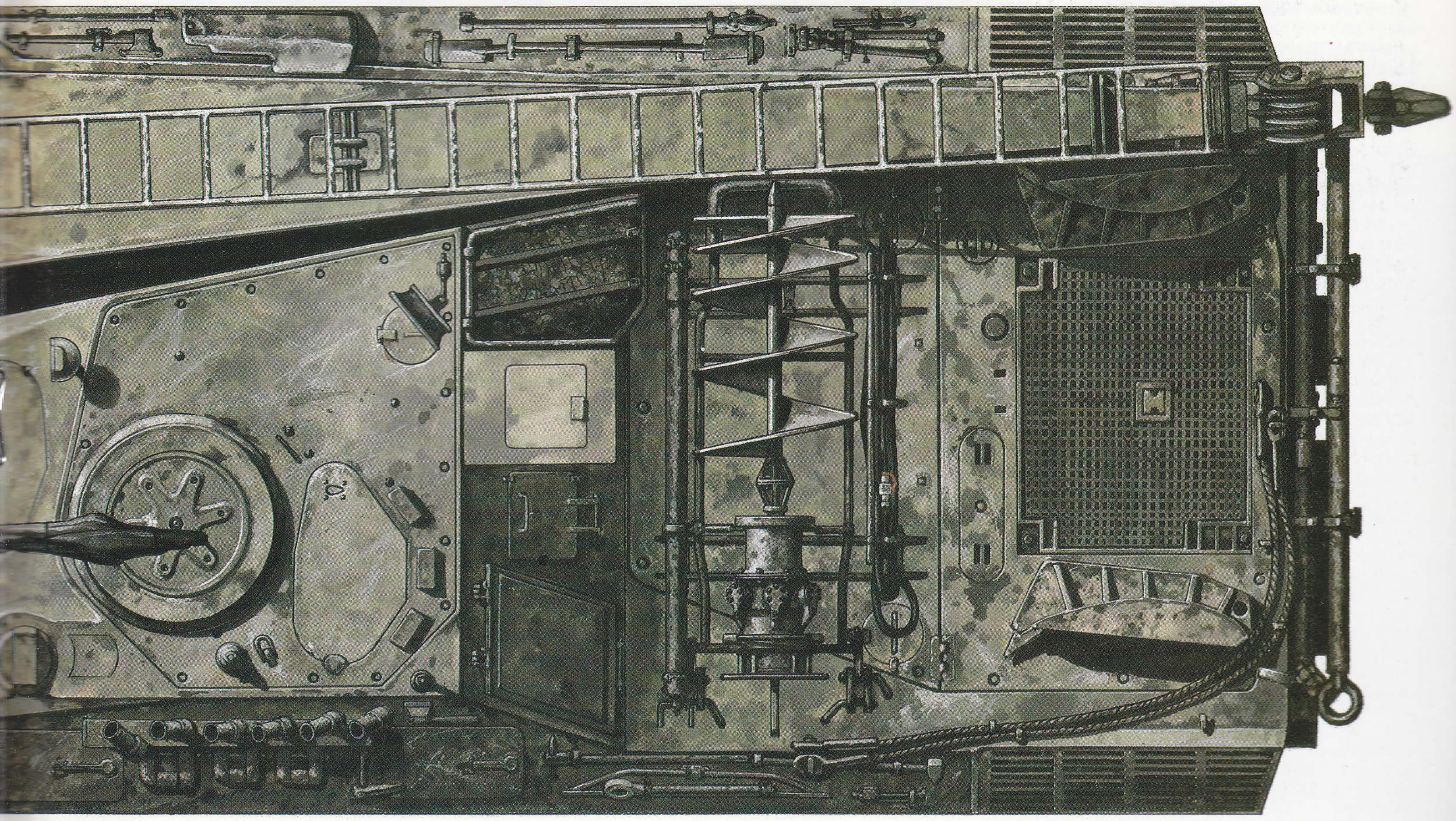


The Leopard 1 Armoured Engineer Vehicle

The Leopard Armoured Engineer Vehicle is based on the chassis of the Leopard 1 MBT and has been designed to carry out a wide variety of missions on the battlefield, including drilling holes for infantry or demolitions, ripping up surfaces of roads to make them impassable to wheeled vehicles, lifting loads with its hydraulic crane, using its dozer blade to remove obstacles or to prepare fire positions for other vehicles and anti-tank weapons, and the preparation of river banks to enable tracked and wheeled vehicles to enter and exit.




PETER SARSON~TONY BRYAN



Fitted at the front of the hull on the right side is a hydraulically-operated crane which can lift a maximum load of 20000 kg (44,092 lb). It can also be fitted at one end with an auger that can drill holes in the ground to a maximum depth of 2 m (6 ft 7 in). Mounted in the lower part of the crew compartment at the front of the hull is the main winch with a capacity of 35000 kg (77,162 lb), a figure which can be doubled with the aid of a pulley.

Standard equipment includes demolition blocks and detonators, tow bars and shackles, and electric welding and cutting gear.

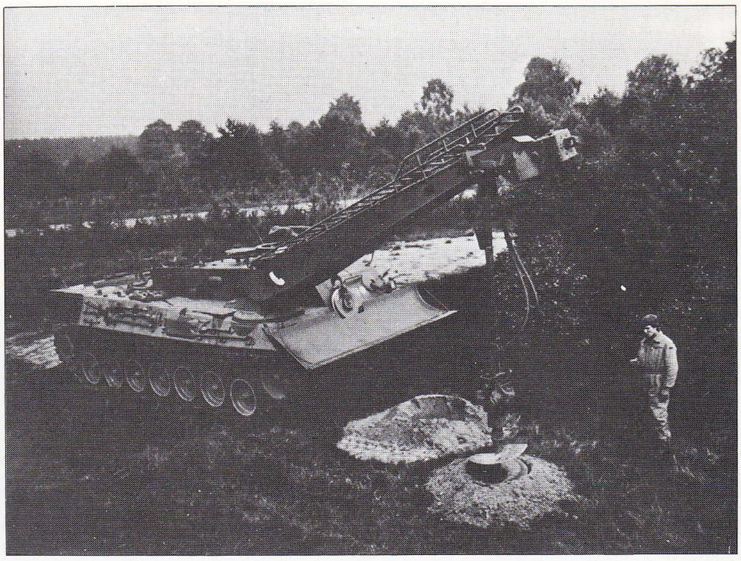
Installed in the front of the hull on the left side is a ball-mounted 7.62-mm (0.3-in) machine-gun, a similar weapon being located on the roof for anti-aircraft defence. A bank of six electrically-operated smoke dischargers is fitted on the left of the hull, firing forwards.

The Leopard 1 AEV is used for a wide range of roles such as preparing fire positions, recovery of bogged-down vehicles, preparing bridges and other high-value targets for demolition, filling in holes and keeping roads clear, to name but a few.

For many years the West German army has had a requirement for a **GPM Engineer Vehicle** which would be used during river crossing operations to keep vehicle entry points clear. Prototypes were built by EWK and Krupp MaK, but because of a shortage of funds production of these vehicles has yet to start. EWK has also built prototypes of a 4×4 **Amphibious Engineer Reconnaissance Vehicle** called the **APE**, but this too has fallen victim to defence cuts.

Specification

Leopard 1 AEV
Crew: 4
Weight: loaded 40800 kg (89,949 lb)
Powerplant: one MTU MB 838 Ca.M500 10-cylinder diesel developing 618.9 kW (830 hp)
Dimensions: length (overall) 7.98 m (26 ft 2.2 in); width (overall) 3.75 m (12 ft 3.6 in); height (with MG) 2.69 m (8 ft 9.9 in)
Performance: maximum road speed 65 km/h (40.4 mph); maximum road range 850 km (528 miles); gradient 60 per cent; fording 2.10 m (6 ft 11 in); vertical obstacle 1.15 m (3 ft 9.3 in); trench 3 m (9 ft 10 in)



A West German army Leopard Armoured Engineer Vehicle uses its auger to bore holes in the ground. The crane can also be used to lift a maximum load of 20 tonnes (44,093 lb). Mounted at the front of the vehicle is a hydraulically-operated dozer blade.

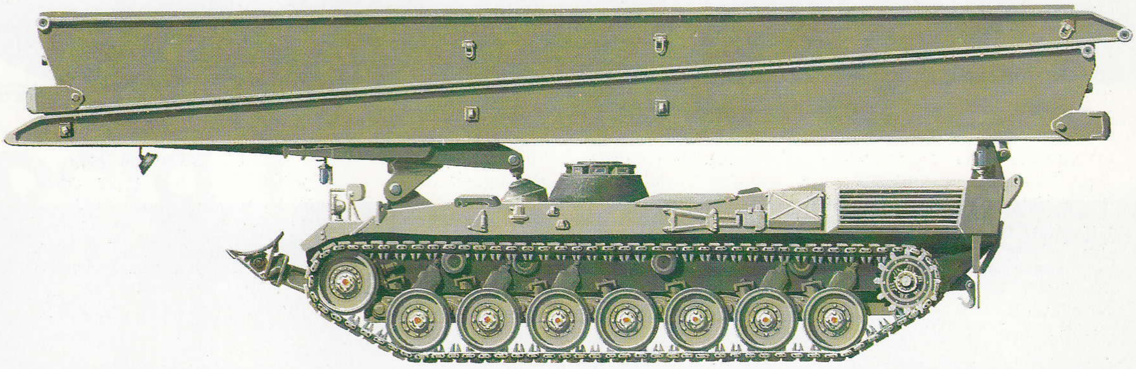
WEST GERMANY

Biber Armoured Vehicle-Launched Bridge

As with the Leopard 1 MBT programme, the West German army decided to build two different bridgelayers for comparative trials, these being known as the Type A and the **Type B**. After troop trials the latter was selected by the West German army and first production vehicles were completed by Krupp MaK Maschinenbau in 1975. In addition to the 105 Leopard armoured bridgelayers built for the West German army, six were built for Canada and 14 for the Netherlands; five were built by Australia. More recently the Italian company OTO Melara has built 64 vehicles for the Italian army. In the West German army the vehicle is commonly called the **Biber** (beaver) although its official designation is the **Brückenlegepanzer Biber**, or **BRLPZ-1** for short.

The hull of the Biber is virtually identical to that of the Leopard 1 MBT, but with its turret replaced by a two-part aluminium bridge. When opened out the bridge has a total length of 22 m (72 ft 2 in) and can be used to span gaps up to a maximum of 20 m (65 ft 7.4 in). As with all bridges of this type the actual gap depends largely on the height and condition of the banks. The bridge can take vehicles up to a maximum weight of 50000 kg (110,231 lb) or 60000 kg (132,277 lb) in an emergency.

Standard equipment on the Biber includes night-vision equipment, an NBC system and four electrically-operated smoke dischargers mounted on each side firing forwards. The Biber can ford to a depth of 1.2 m (3 ft 11 in) without preparation, though with some preparation this can be increased to 1.65 m (5 ft 5 in). Mounted at the front of the hull is a support blade which is normally lowered before the bridge is placed in position, although it can be used as a dozer to make certain the surface under the bridge is level. Normally such levelling and grading operations would be carried out by other vehicles.

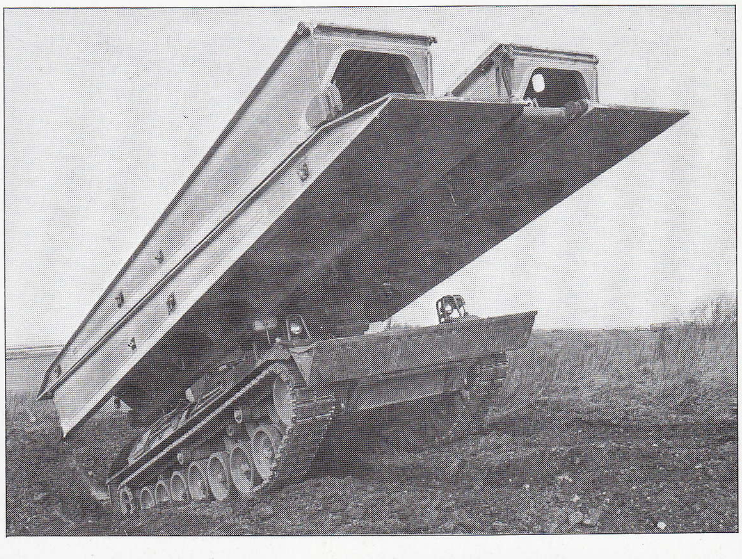


Above: A West German Biber armoured vehicle-launched bridge (AVLB) is shown in the travelling configuration. It is also used by Australia, Canada, Italy and the Netherlands. When opened out, its bridge is 22 m (72 ft) long, and can span a gap of 20 m (65 ft).

The Biber bridge is normally employed as follows. Forward elements know that ahead of them is a gap that has to be crossed with the aid of a Biber. Tanks are deployed as far forward as possible to give covering fire while the Biber is brought up. On arriving at the river the Biber first lowers its support blade. The lower half of the bridge then slides forward until its end is lined up with the end of the upper half. The two sections of the bridge are then locked together and the complete bridge is extended across the gap and lowered into position. The cantilever arms are then withdrawn, the support blade is raised and the vehicle is driven away so that the tanks can cross. The bridge itself can be picked up from either end and used again.

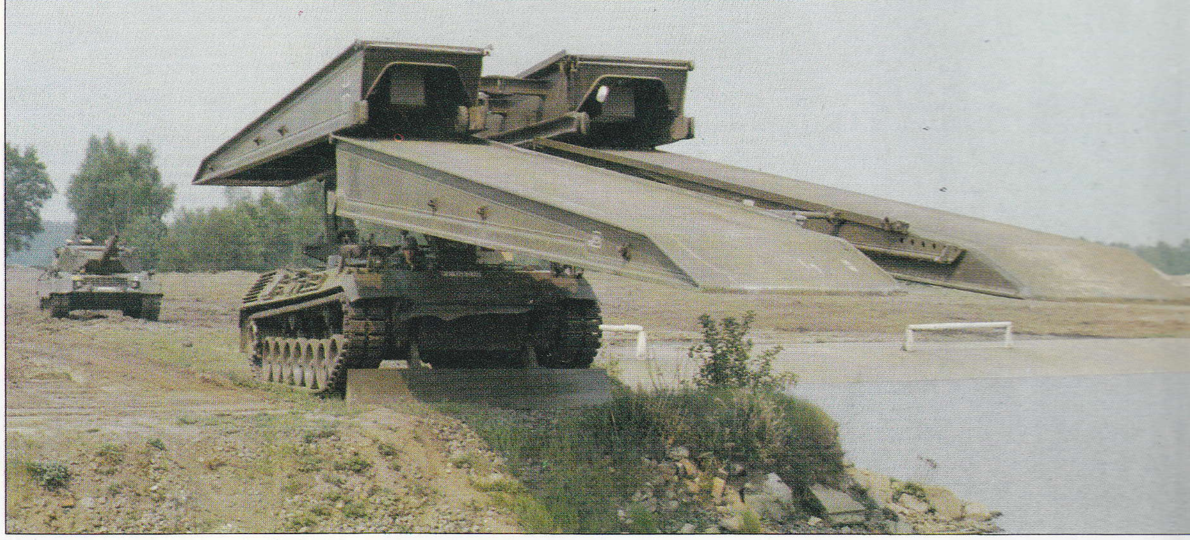
Specification

Biber
Crew: 2
Weight: with bridge 45300 kg (99,869 lb)
Powerplant: one MTU MB 838 Ca.M500 10-cylinder multi-fuel engine developing 618.9 kW (830 hp)
Dimensions: length (with bridge) 11.82 m (38 ft 9.4 in); width (with



The Biber armoured vehicle-launched bridge is based on the chassis of the Leopard 1 MBT. An advantage of the Biber bridge over some other types is that it is laid horizontally, rather than vertically, so making detection more difficult.

bridge) 4.00 m (13 ft 1.5 in); height (with bridge) 3.57 m (11 ft 8.6 in)
Performance: maximum road speed 62 km/h (38.5 mph); maximum range 550 km (342 miles); fording 1.2 m (3 ft 11 in); gradient 60 per cent; vertical obstacle 0.7 m (2 ft 3.6 in); trench 2.5 m (8 ft 2.4 in)



A West German army Biber armoured bridgelayer extends the lower part of its bridge. The two parts are then locked together and the complete bridge is extended across the gap. Under the nose of the Biber is a hydraulic blade, which can be used as a stabilizer or dozer blade.

USSR

MTU-20 Armoured Vehicle-Launched Bridge

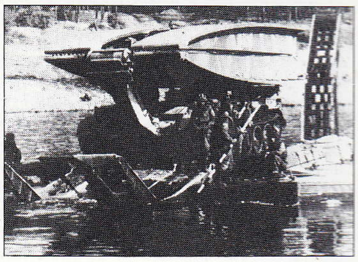
After the end of World War II at least three armoured bridgelayers based on the chassis of the T-34 tank were developed and placed in service, two by the Soviet Union and one by Czechoslovakia (MT-34). In the 1950s the Soviet T-34 armoured bridgelayers were replaced by the **MTU** system based on a T-54 or T-55 tank chassis with its turret replaced by a cantilever launching mechanism and a bridge. The latter is launched over the front of the vehicle, and is 12.3 m (40 ft 4 in) long and can span a gap of up to 11 m (36 ft 1 in).

In the late 1960s this was replaced by the **MTU-20** in front-line Soviet units. The main difference between the original MTU and the more recent MTU-20 is that the latter has a bridge that when opened out is 20 m (65 ft 7 in) long and can span a gap of 18 m (59 ft 1 in). To reduce the overall length of the system for travelling, the front and rear parts of the bridge are swung upwards through 180° so that they rest on top of the central portion. The bridge is launched as follows. The MTU-20 approaches the obstacle to be crossed and comes to a halt. The stabilizers are lowered at the front of the vehicle and the ends of the bridge are unfolded and locked into position. A chain system then moves the complete bridge along the cantilever launching girder until the end of the bridge reaches the far bank. The launching girder is then depressed and the end of the bridge lowered onto the far bank. The tank then withdraws and vehicles can cross. The bridge can be recovered from either end in a similar time. The MTU-20 and older MTU have been built in significant numbers and exported to many countries.

Two members of the Warsaw Pact, Czechoslovakia and East Germany, have built their own armoured bridgelayers. The East German system is called **BLG-60** and was developed with the assistance of Poland. It has a scissors-type bridge that is launched over the front of the vehicle. In position this is 21.6 m (70 ft 10 in) long and can span a gap of up to 20 m (65 ft 7 in). The Czech system is the **MT-55** and is based on a T-55 chassis. This has a scissors-type bridge that is launched over the front of the vehicle. In position this is 18 m (59 ft 1 in) long and can span a gap of 16 m (52 ft 6 in). The bridge takes about 3 minutes to be positioned and 6 minutes to be recovered. The MT-55 has an NBC system, night-vision equipment and a system to ensure that the bridge is long enough to span the obstacle. In addition to being used by Czechoslovakia and the USSR, it has been exported to a number of countries including Yugoslavia. The Israeli army captured a quantity of MT-55 armoured bridgelayers in the 1973 Middle East conflict.

Specification

MTU-20
Crew: 2
Weight: 37500 kg (82,673 lb)
Powerplant: one V-55 12-cylinder diesel developing 432.5 kW (580 hp)
Dimensions: length (with bridge) 11.64 m (38 ft 2.3 in); width (with bridge) 3.30 m (10 ft 9.9 in); height (with bridge) 3.40 m (11 ft 1.9 in)
Performance: maximum road speed 50 km/h (31.1 mph); maximum range 500 km (311 miles); fording 1.4 m (4 ft 7 in); gradient 40 per cent; vertical obstacle 0.8 m (2 ft 8 in); trench 2.7 m (8 ft 10 in)

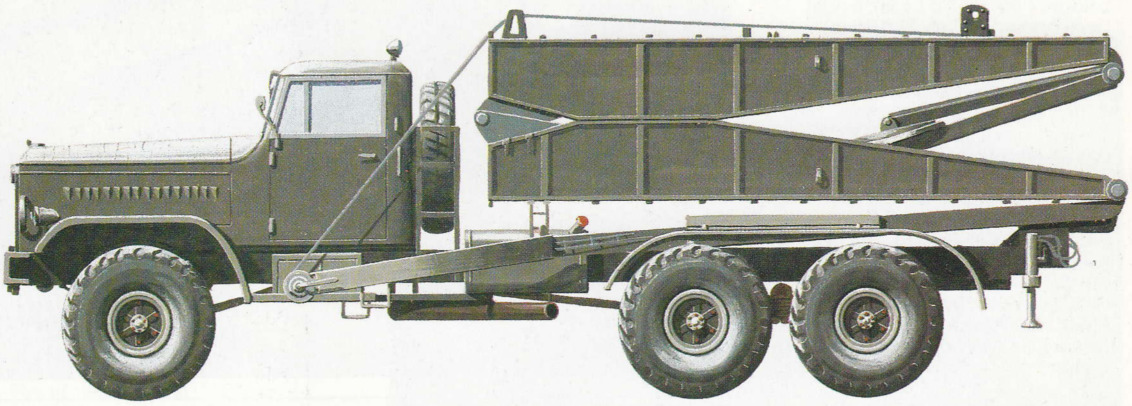


A Soviet MTU armoured bridgelayer on a T-55 tank chassis is seen in the travelling configuration. This model entered service with the Soviet army in the 1950s as a replacement for an earlier system mounted on the T-34 tank chassis.

An MTU-20 armoured bridgelayer of the Finnish army approaches its launch position on a recent exercise. When fully open the bridge is 20 m (65 ft) long, and can span a gap of up to 18 m (59 ft), representing a considerable improvement over the older MTU.

USSR

TMM Truck-Mounted Treadway Bridge



Above: A Soviet TMM truck-mounted treadway bridge system in the travelling mode is mounted on the rear of the older KrAZ-214 (6×6) cross-country truck. More recent models are mounted on the more powerful KrAZ-255B (6×6) truck chassis, which is also used to carry and launch the PMP system.

The **TMM** treadway bridge was initially carried and launched from the KrAZ-214 6×6 truck. In most front-line units the truck itself has now been replaced by the KrAZ-255B 6×6 truck, resulting in the revised designation **TMM-3**.

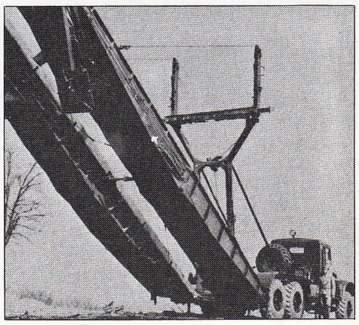
The TMM truck-mounted treadway bridge consists of four spans, each of which are launched and recovered over the rear of a KrAZ-214 truck chassis. Three of the spans have adjustable trestle legs while the fourth does not as it is the link between the third span and the far bank.

The TMM can be used to span both wet and dry gaps and is employed as follows. First the height of the treadway legs are carefully adjusted for the correct height so that when the bridge is laid in position it is level. (If the exact depth of water is not known in advance or if the bottom is muddy this can be a major problem.) When travelling the treadway legs are folded up and stored under the folded scissors bridge, while the treadways are closed up to reduce the overall width of the vehicle. Once the treadways have been extended, and the trestles fitted and adjusted for height, the truck backs up to the edge of the gap. A hydraulically-operated launching girder raises the folded span into the vertical position, where it is opened and locked in position. As it is lowered down by the winch system the integral trestle legs swing into place. Once the trestle legs are emplaced the cables are disconnected, the launching girder retracted into the travelling position on the rear of the truck, the truck is driven off to pick up the next span and the same procedure is repeated until the far shore span is emplaced. As mentioned previously a basic unit consists of three spans and one shore span, but more can be used if required. A basic unit can span a gap of 40 m (131 ft 3 in) in between 45 and 60 minutes under good conditions. Each bridge section weighs about 7000 kg (15,432 lb), has a capacity of 6000 kg (13,228 lb) and is 10.5 m (34 ft 5 in) long.

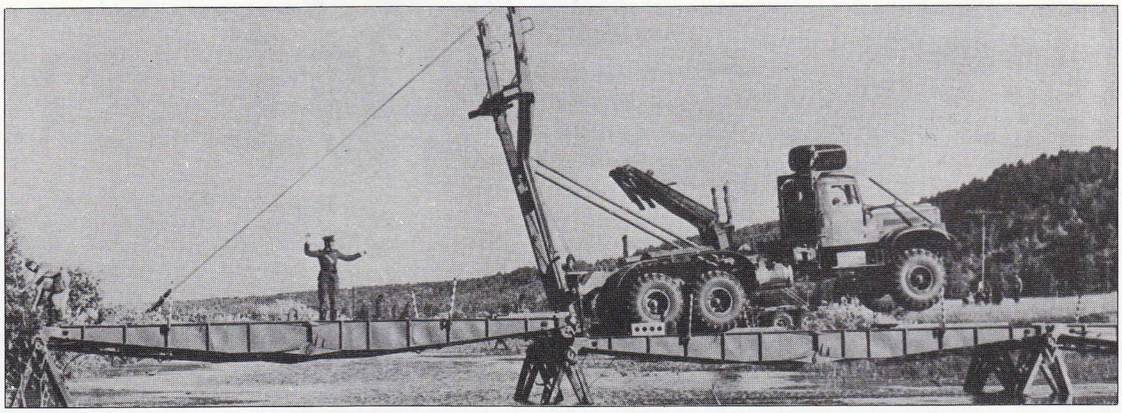
The older **KMM** truck-mounted treadway bridge system is similar in concept but is carried on the rear of ZIL-157 6×6 truck chassis, with one unit consisting of four spans and one shore span. The KMM unit can, however, span a gap of only about 34 m (111 ft 7 in) and has a capacity of about 12000 kg (26,455 lb), which severely restricts the type of vehicle, especially armoured, that can use the bridge.

West Germany developed a system similar to the TMM called the **SAS** bridgelayer but based on a Leopard 1 chassis. At the forward end of each bridge are two legs which are hydraulically opened and then lowered into position. The SAS system has not so far been placed in production.

Specification
TMM
Crew: 3
Weight: 19500 kg (42,990 lb)
Powerplant: one YaMZ M206B 6-cylinder water-cooled diesel developing 152.9 kW (205 bhp)
Dimensions: length (with bridge) 9.30 m (30 ft 6.1 in); width (with bridge) 3.20 m (10 ft 6 in); height (with bridge) 3.15 m (10 ft 4 in)
Performance: maximum road speed 55 km/h (34.2 mph); maximum road range 530 km (329 miles); fording 1.0 m (3 ft 3 in); gradient 60 per cent; vertical obstacle 0.4 m (1 ft 4 in); trench no capability



Above: A KrAZ-214 (6×6) cross-country truck lays a TMM treadway bridge into position, and shows its adjustable trestle legs starting to unfold. A complete set of four treadway sections can be laid across a gap by a well-trained crew in 45-60 minutes in daylight.

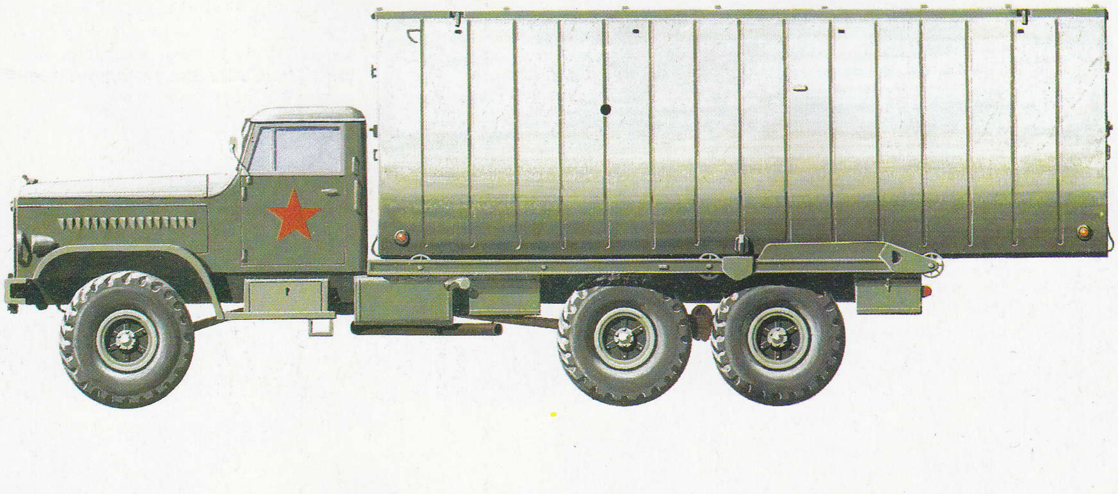


A KrAZ-255B (6×6) cross-country truck lays its opened scissors bridge in position. A complete TMM system consists of three spans with adjustable legs, and a shore span which does not have an adjustable leg and is the link between the third span and the far bank.

USSR

PMP Heavy Floating Bridge

The **Pomtommo Mostovoy Park (PMP)** heavy folding pontoon bridge entered service with the Soviet Union in the 1960s and has since been adopted by every member of the Warsaw Pact except Poland (which uses the locally-produced **PP-64** system) and Romania (which uses the **RR-60**). The PMP has also been exported on a large scale and was successfully used by the Egyptian army while crossing the Suez Canal in 1973.



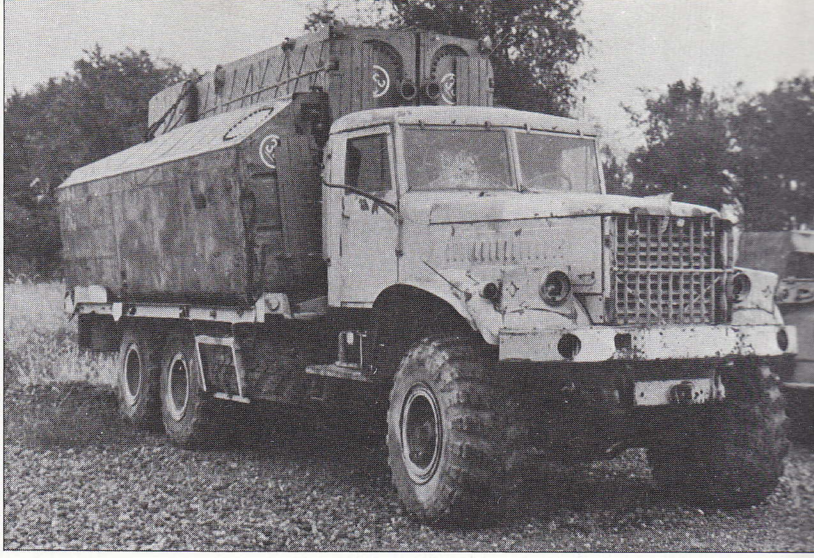
The Soviet PMP heavy folding pontoon bridge system consists of river and shore pontoons that are carried and launched from 6×6 KrAZ-214 or the more recent KrAZ-255B truck.

PMP Heavy Floating Bridge (continued)

The PMP originally entered service mounted on the rear of the KrAZ-214 6×6 chassis, but Soviet PMP systems are now on the more recent KrAZ-255 6×6 chassis, although many foreign countries use local chassis: for example Egypt has fitted its systems onto the rear of West German Magirus-Deutz 6×6 chassis while Czechoslovakia uses the Tatra-813 8×8 chassis. Some of the latter have been fitted at the front of the hull with a hydraulically-operated dozer blade that can be used to clear obstacles or prepare river banks before the launching of the pontoons.

The PMP system consists of two main elements, both of which are carried folded on the rear of the truck. The two pontoon types are the river and shore, each of them of all-steel construction and launched in the same manner. The truck backs up to the water's edge, the catches are released and the pontoon rolls off the back of the truck into the water, where it automatically unfolds. Once the pontoons have been locked they are coupled up to form a bridge. A complete PMP pontoon set consists of 32 river pontoons, four shore pontoons and 12 bridging boats. This is sufficient to make a pontoon with a capacity of 20000 kg (44,092 lb) some 389 m (425 yards) long or a 60000 kg (132,277-lb) bridge 227 m (248 yards) long. The former takes about 50 minutes to position, while the latter takes about 30 minutes. The bridging boats are used to hold the pontoon bridge in position, especially in fast-flowing rivers. The pontoons can also be used to form ferries which are then pushed across wide rivers by bridging boats. A 60000-kg ferry can be constructed from three pontoons in 10 minutes.

The USA has reverse-engineered the PMP into the **Ribbon Bridge**, and this entered service with the US Army in the mid-1970s. The American version has many improvements and is also much lighter as it is made of aluminium rather than steel. It is also made under licence by EWK in West Germany as the **Bundeswehr Ribbon Bridge**, and this model has been adopted by Belgium, Egypt, the Netherlands and Sweden. EWK has also supplied steel versions which are interchangeable with the original Soviet pontoons; these have been supplied to Egypt.



A KrAZ-214 (6×6) cross-country truck carries a PMP shore pontoon. A standard PMP set consists of 32 river pontoons, four shore pontoons and 12 bridging boats, which are used to hold the completed pontoon bridge in position or to push rafts of PMP pontoons.

Specification

River Pontoon
Weight: 6676 kg (14,718 lb)
Dimensions: length (open) 6.75 m (22 ft 1.75 in); width (open) 7.10 m (23 ft 3.5 in); depth (open) 0.915 m (3 ft 0 in)

Shore Pontoon
Weight: 7252 kg (15,988 lb)
Dimensions: length (open) 5.58 m (18 ft 3.7 in); width (open) 7.02 m (23 ft 0.4 in); depth (open) 0.73 m (2 ft 4.7 in)

USSR

IMR Combat Engineer Vehicle

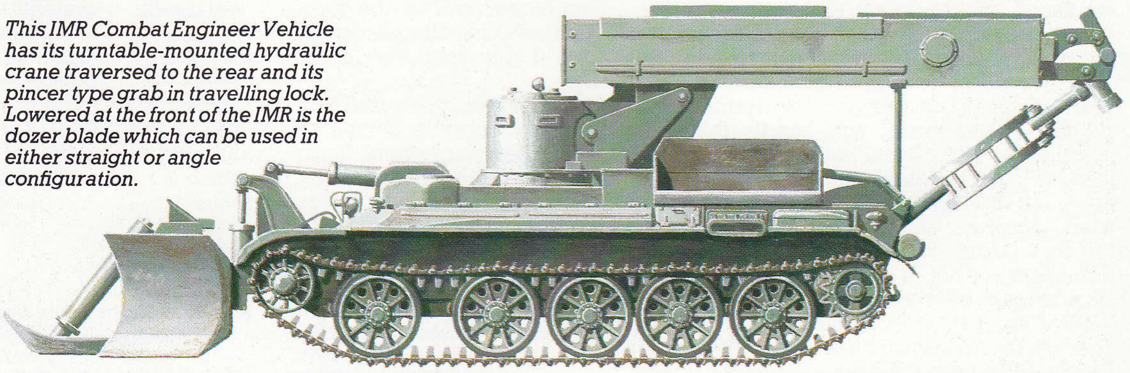
The **IMR Combat Engineer Vehicle** was introduced into the Soviet army in the early 1970s, and is also used by some members of the Warsaw Pact as well as by Yugoslavia. The IMR consists essentially of a T-55 tank with its standard turret replaced by a new turret with a hydraulic crane and an armoured cupola for the crane operator. The crane has a telescopic jib, and when travelling is normally traversed to the rear to reduce the overall length of the vehicle. The crane is usually fitted with a pincer-type device for ripping trees out of the ground. The pincer can be replaced by a bucket which is normally carried on the left side of the hull when not required. This bucket is quite small, and so has only limited earthmoving capabilities.

Mounted at the front of the hull is the hydraulically-operated dozer blade, which is controlled from within the safety of the IMR by the driver. The dozer blade can be used in the normal straight configuration or at a V-angle. The IMR has night-vision equipment, and like most vehicles based on the chassis of the T-54/T-55 tank can also lay its own smoke screen. Mounted at the rear of the hull is an unditching beam, another common feature on current Soviet tanks, although such a device was pioneered by the British during World War I: if the vehicle becomes stuck in the mud the unditching beam is removed from the rear and attached under the lower forward part of the tracks to improve traction.

Compared with Western vehicles, the Soviet IMR has very limited capabilities as it has no demolition device (as is fitted to the French EBG, American M728 CEV and British Centurion Mk 5 AVRE), cannot lay a minefield (as can the French EBG) and would require some time to prepare fire positions for other vehicles. In the Soviet Union many of these roles are undertaken by other vehicles, and in any case the Soviet army is far more offensively minded than Western armies.

The Soviet army does have a wide variety of specialized trench diggers in service, these normally being mounted on full-tracked chassis such as that of the AT-T heavy tracked artillery tractor. One of these is the **BTM** ditching machine, which is essentially the AT-T fitted with the ETR-409 ditching machine at the rear. This machine is quite capable of digging a trench 1.5 m (4 ft 11 in) deep and 0.8 m (2 ft 7.5 in) wide at the rate of about 1100 m (1,203 yards) per hour, although this very much depends on the type of soil and the time of year.

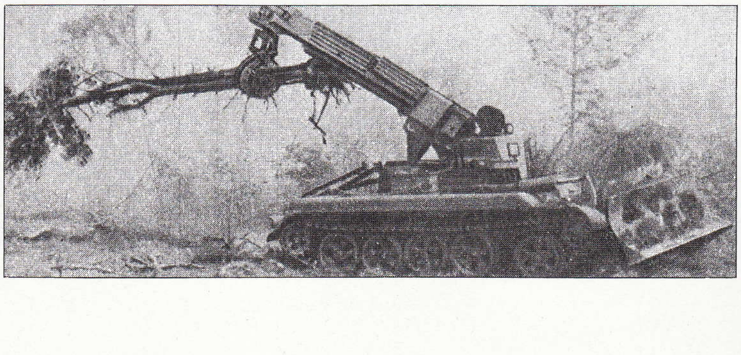
This IMR Combat Engineer Vehicle has its turntable-mounted hydraulic crane traversed to the rear and its pincer type grab in travelling lock. Lowered at the front of the IMR is the dozer blade which can be used in either straight or angle configuration.



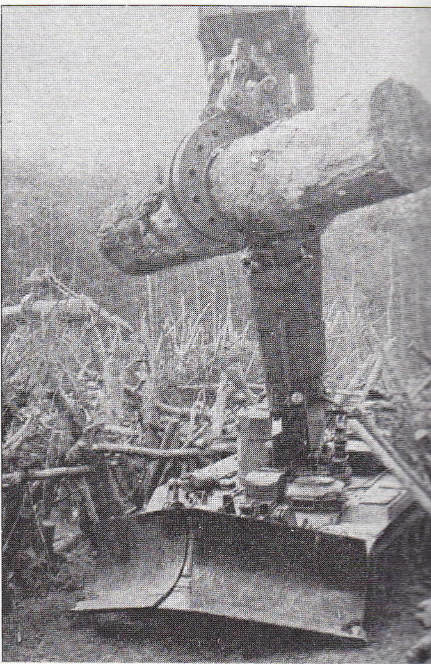
Specification

IMR
Crew: 2
Weight: 34000 kg (74,957 lb)
Powerplant: one Model V-55 V-12 diesel developing 432.5 kW (580 hp)
Dimensions: length (overall) 10.60 m (34 ft 9.3 in); width (overall) 3.48 m (11 ft 5 in); height (cupola) 2.48 m (8 ft 1.6 in)
Performance: maximum road speed 48 km/h (29.8 mph); maximum range 400 km (249 miles); fording 1.40 m (4 ft 7 in); gradient 60 per cent; vertical obstacle 0.8 m (2 ft 7.5 in); trench 2.7 m (8 ft 10.3 in)

An IMR Combat Engineer Vehicle of the Soviet army is seen in action with the jib of the hydraulic crane extended to the rear and fitted with a pair of pincer-type grabs, which can be used for a variety of roles on the battlefield such as ripping out trees and other obstacles.



Below: An IMR Combat Engineer Vehicle uses its pincer grab to remove a tree trunk during operations in a forward battlefield area. The hydraulically-operated dozer blade mounted at the front of the IMR is in the V-configuration to clear a path through debris as quickly as possible.



Digging for Victory

For an army on the defensive, prepared positions are of enormous value. In 1973 the Israelis defeated vastly superior forces by the skilful use of tank firing positions and measured killing grounds. NATO's defensive posture in Germany would be dramatically enhanced by the construction of similar earthworks, but this would be politically difficult, so if the Soviets ever do invade the Royal Engineers will have to work very fast indeed.

Peacetime rivalry between army units runs high, ranging from the friendly variety to out-and-out dislike. Often there is no good reason for it, or if there is a reason it is buried in history. Often it is a result of the fear that there may just be another regiment or corps that is not only as skilled as your own, but is possibly a little bit better. So the infantry squabble amongst themselves and then unite against the tankies or gunners, and they are all disparaging about non-teeth arms, or those who might hear a shot fired in anger but are themselves unlikely to do much shooting. And, of course, those other arms tend to be slightly contemptuous of the 'grunts' and 'gruntcrushers', who are deemed incapable of understanding the fact that other arms do play a vital role in today's army. And so it goes on, all very harmless really and all totally forgotten when the shooting starts (but not in the subsequent post-mortem) – except possibly in one instance. In the British army at least there is one regiment rarely, if ever, 'badmouthed'; one regiment that continually impresses soldier and civilian alike with its abilities and out-and-out professionalism; and one regiment whose members are all trained soldiers of the tooth arm variety (trained and proved in past wars), who handle the most complex machinery and equipment. That regiment is, naturally, the Royal Engineers. This is not to say that the Royal Electrical and Mechanical Engineers, the Royal Corps of Transport, the Royal Army Ordnance Corps and other formations are not as skilled, but that the Royal Engineers do have an incredibly complex role to play, and play it exceedingly well. It is, by analogy, the difference between the Parachute Regiment and Royal Marines: both are superb units, that having the edge being decided by one's particular point of view.

The Royal Engineers have always been well in the thick of things. They got their nickname, the Sappers, because centuries ago they were the men who dug the way forward in ditches (called 'saps') in order to breach fortress walls. Sappers led the way through minefields at El Alamein in 1942, and cleared the beaches at Normandy in 1944. They have the reputation of being able to turn their hands to anything: in the army, when in doubt, you send for a Sapper.

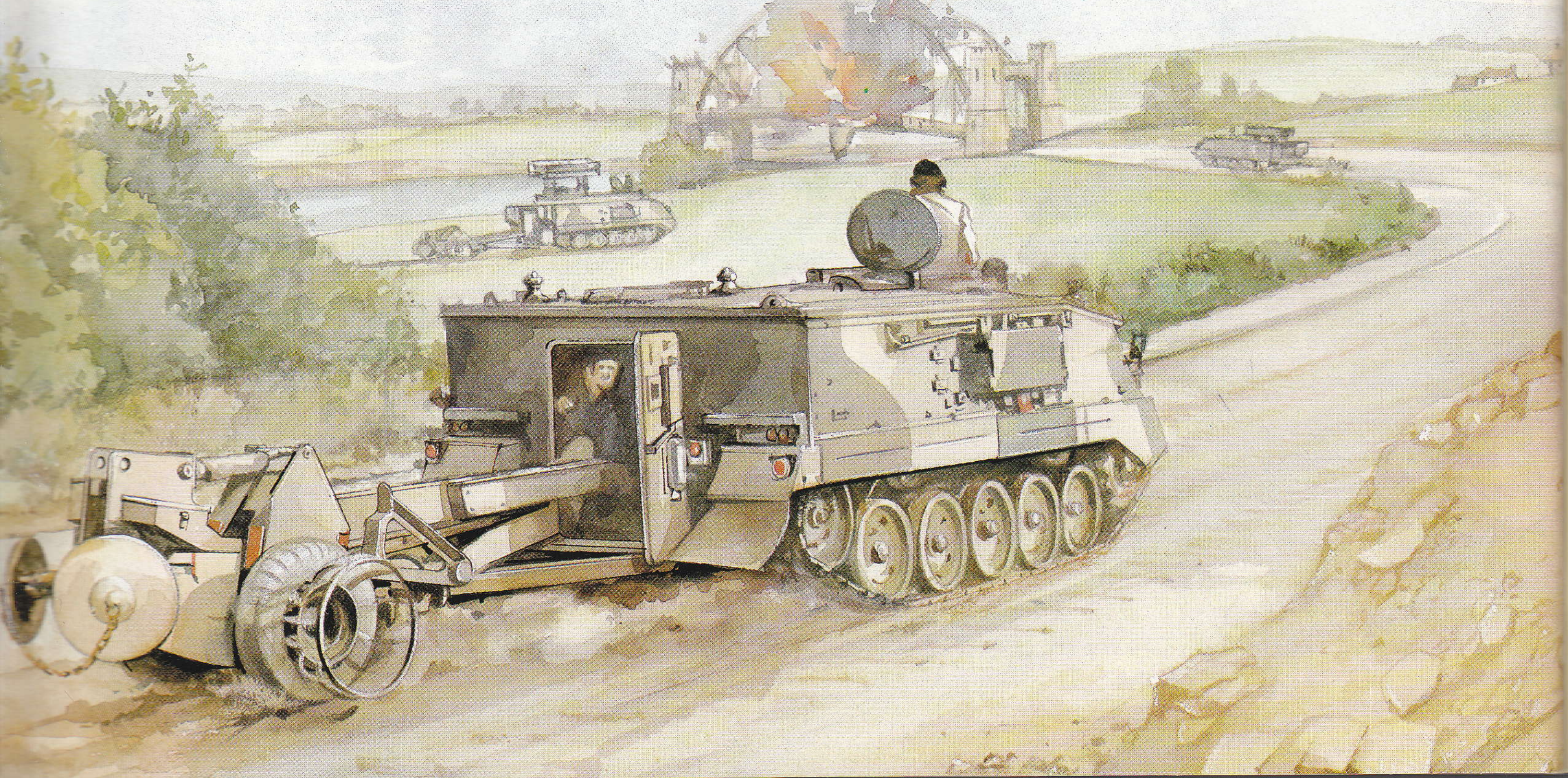
The ubiquitous Sapper

Sappers are to be found throughout the world, throughout the army and all over the battlefield. They build bridges, make maps, build airfields and bulk petroleum installations, build ferries, clear and lay mines and booby-traps, dispose of unexploded bombs, repair heavy vehicles, lay bricks, drill wells, survey anything that needs surveying, drive cranes and also manage to provide the postal and courier service for the forces – worldwide. Their motto is *Ubique* (everywhere), and for once it is a motto that means exactly what it says.

Thus it is certainly true that the Sappers are the most versatile combat engineers in any armed forces anywhere. It might be interesting now to look at the Sappers in action, not in some past war, but in a future war that, hopefully, will never take place. The scenario is that the Warsaw Pact forces have crossed over the West German border and are starting their inexorable advance towards the Channel. The main Warsaw Pact advance is undertaken by the 3rd Shock Army (it was once called the 3rd Mechanized Army, but Shock Army pleases propagandists on both sides), accompanied by various East German, Polish and Hungarian units, none of which is really trusted by Moscow and thus used only in supporting roles.

Sapper combat engineer units (those who are trained to do their jobs right in the thick of things, often far in advance of their own lines) come in a variety of shapes and sizes. There are field engineers, armoured engineers, amphibious engineers, parachute and commando engineers. They operate with regular infantry and armoured detachments, and often totally on their own. You can find them travelling in Stalwarts, Scorpions (used as command vehicles), Chieftain tanks complete with bridgelaying unit, armoured personnel carriers (often fitted with a special minelaying plough called a Bar Minelayer), M2 amphibious units, medium wheeled tractors, Land Rovers and assault craft. No doubt this list omits a few items, because part of the Sappers' genius lies in having available the right piece of equipment at the right time, an ability that leaves the rest of the army, accustomed as it is to the wrong piece of kit arriving at the wrong time, frankly dumbfounded but very, very grateful. The rest of the army have also grown accustomed to small detachments of Sappers (often far smaller than expected) turning up, doing whatever is required, and then vanishing as mysteriously as they arrived. It is almost as if there are, in addition to those Sapper units on permanent attachment to larger formations, other Sapper units with a roving battlefield commission to wander around, generally right-

The Royal Engineers will have a vital role to play on any future battlefield in Europe as part of the combined arms team, which also includes infantry, artillery, armour and helicopters. Here FV432 armoured personnel carriers towing Bar Minelayers rush to the forward area to lay anti-tank mines to disrupt and slow down enemy units, while a Combat Engineer Tractor starts to prepare fire positions for MBTs and anti-tank guided weapons. Once the mines had been laid Royal Engineers would make the road impassable by making deep craters with high-explosive charges.

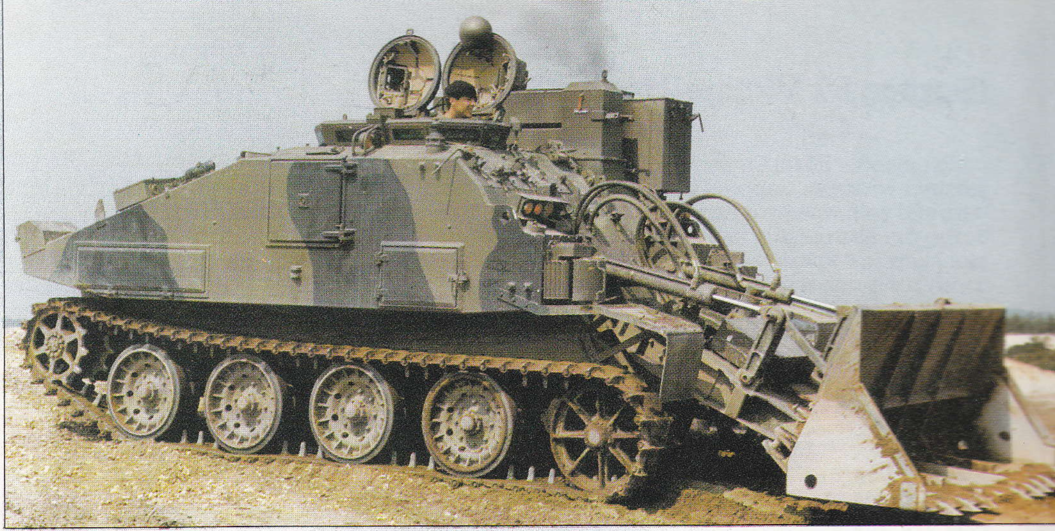


ing wrongs and bringing some element of order to a fairly confused situation.

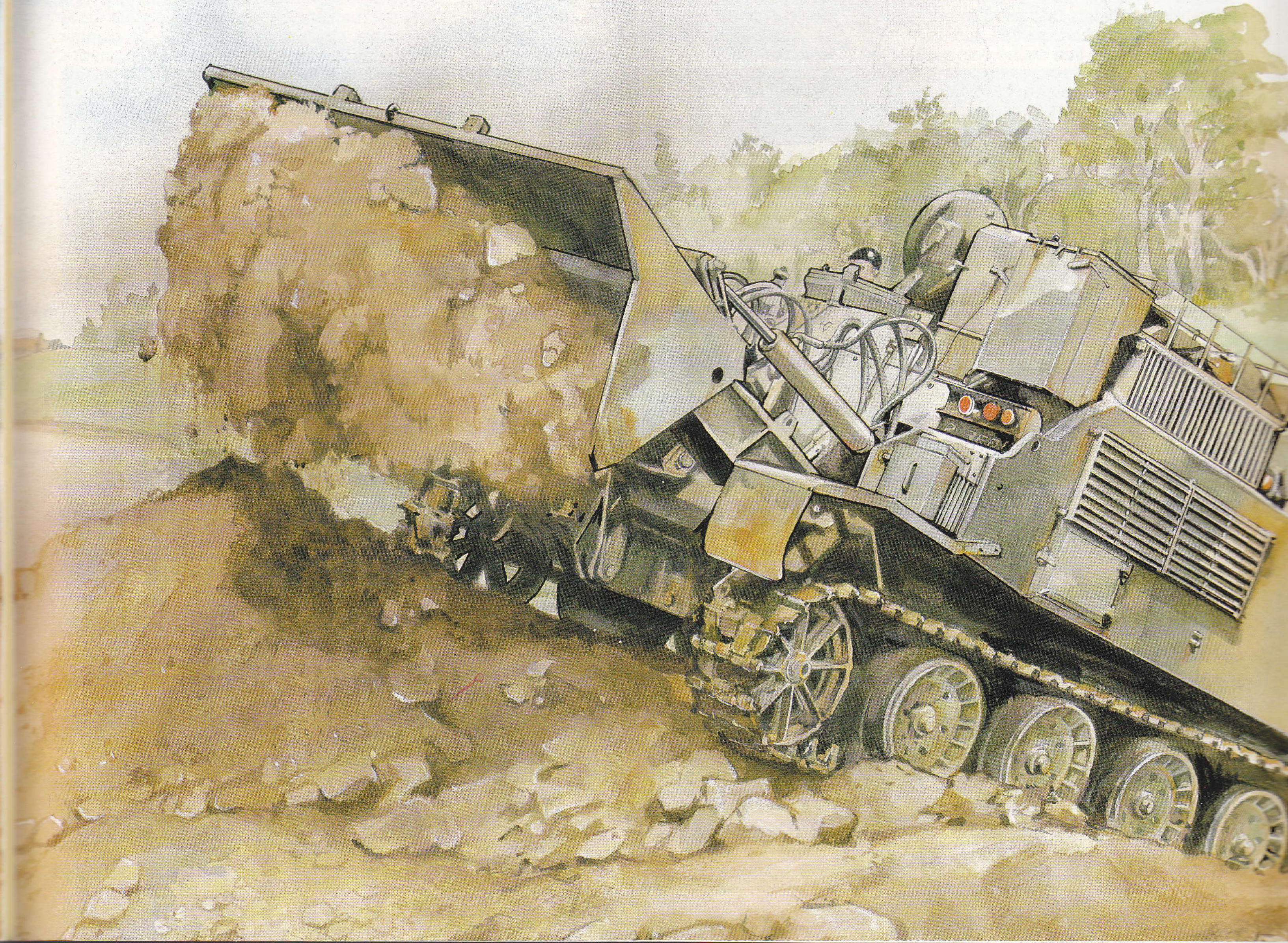
However, back to the scenario. The 3rd Shock Army has poured across the border and is even now hotfooting it towards the River Weser. This river forms a natural secondary barrier, and is anyway the river that NATO war games and exercises assume to be the 3rd Shock Army's objective. However, assuming that the Weser is still as important an objective as ever, the 3rd Shock Army must be held up there for as long as possible to give time for the USA to begin airlifting troops from America to Europe, to allow NATO forces in situ time to regroup, and to compel the Soviet advance to telescope upon itself, which leads to congestion and easy targets for regular artillery, the new NATO multiple rocket-launchers and air strikes. It is hoped, moreover, that a delayed advance may result in the Warsaw Pact beginning to disintegrate, as there is little or no natural love between many of its constituent countries. For all these reasons, the Weser is an important objective, either to gain or to hold.

Amphibious capability

By all accounts, river crossing ranks high in the Soviet skill at arms. The Soviets have, or rather had, a greater amphibious capability than most other armies in the world, and for this reason are unlikely to rely too heavily on finding bridges intact. However, a river crossing under fire or in bad weather conditions is one of the hardest and most dangerous military operations one can imagine. So the 3rd Shock Army is interested in finding those bridges intact, or at least in gaining control of the most advantageous river crossing positions before the main armour force arrives. So forward elements have been dispatched to achieve those objectives: regular paratroops and Spetsnaz (Soviet special forces trained to operate in enemy uniform), plus armoured reconnaissance troops. Their arrival may be heralded by a chemical weapon strike; it certainly is prefaced by the arrival of thousands of refugees fleeing the Soviet advance and causing as much mayhem (albeit unintentional on their part) as any incapacitating chemical. It is against this background that our Sapper unit has to achieve its objective, which is simply to deny 3rd Shock Army the western bank of the Weser for as long as possible.



The British Combat Engineer Tractor has been designed to meet the demanding requirements of the Royal Engineers, and can be used for a wide range of battlefield roles such as clearing debris and preparing fire positions for armoured vehicles. It is fully amphibious.



Commander Royal Engineers (CRE) has dispatched whatever Sappers in whatever numbers and with whatever equipment needed to do the job. As a result of the general confusion it is unlikely that this detachment bears any relationship with the standard ones as laid down in Staff Duties in the Field. This particular detachment is to mine whatever bridges it can; sow minefields wherever it can; place booby traps wherever it can; and help any NATO forces in the area. It is also ready to conduct its own river crossing, or rather set one up, if a counterattack or flanking movement appears possible. It is to operate independently and to use its own initiative. Depending on the state of the battle, it may be accompanied part of the way by another special Sapper unit that specializes in setting up landing clearings for BAe Harrier V/STOL close support aircraft.

This is not a large, ungainly column of Sappers plus kit fighting its way through the oncoming refugees. Much of their kit will already be in position; other items can be summoned very quickly from rear echelon. Nonetheless, the Sappers have APCs with Bar Minelayers, Scorpion command vehicles, Stalwarts and Land Rovers. They are accompanied by infantry (Sappers are good, but they cannot be expected to do everything themselves) and artillery, probably the new tracked multiple rocket-launchers. But the first detachment of Sappers is either airlifted or parachuted in. Optimum river crossing sites were surveyed years ago, and the Sappers make directly for these, plus any likely bridges. The bridges are blown, quickly, economically and very thoroughly. Mines are laid on the east bank of the Weser opposite river crossing sites. One group of Sappers is setting up booby traps in locations likely to be of use to the oncoming 3rd Shock Army, locations such as power stations, telephone exchanges, airfield control towers, even local hotels that look as if they could usefully be commandeered as a 3rd Shock Army forward headquarters.

Other Sappers are helping the infantry and gunners set up their own defensive positions; specially shaped charges 'dig' trenches and foxholes far faster than even a detachment from the Pioneer Corps (and that is very quick indeed); tractors are building earthworks; other Sappers are blowing up roads (and buildings so that they fall across roads). River banks are blown away, and mines laid in the river itself.

But (and this is a very important 'but' indeed), it would be wrong to get the impression that this is a bunch of Sappers out to cause as much damage and destruction as it can. The truth is a little more subtle than that.

Warsaw Pact supremacy

NATO forces realized a long time ago that, short of building up their own conventional forces to equal those of the Warsaw Pact (which appears to be economically and politically unacceptable), there is no way that NATO can resist the initial Soviet advance, short of using tactical nuclear weapons from the outset; even though the British and one or two other NATO armies are, man for man, the finest troops in the world; even though their equipment is (finally) being dictated as much by military as political considerations; and even though NATO troops are better led, better motivated and less prone to argue amongst themselves. The fact is that there are simply too many Soviet and Warsaw Pact forces, and that these forces will advance on a fairly broad front.

The modern NATO strategy is to force the Warsaw Pact advance into 'killing zones', areas already known and sighted by divisional artillery. In terms of the scenario, the idea is to force the 3rd Shock Army into a narrower line of advance, where it can be attacked not just from the front but from the sides as well. This strategy extends down to the battlefield, certainly as far as brigade and often to company level.

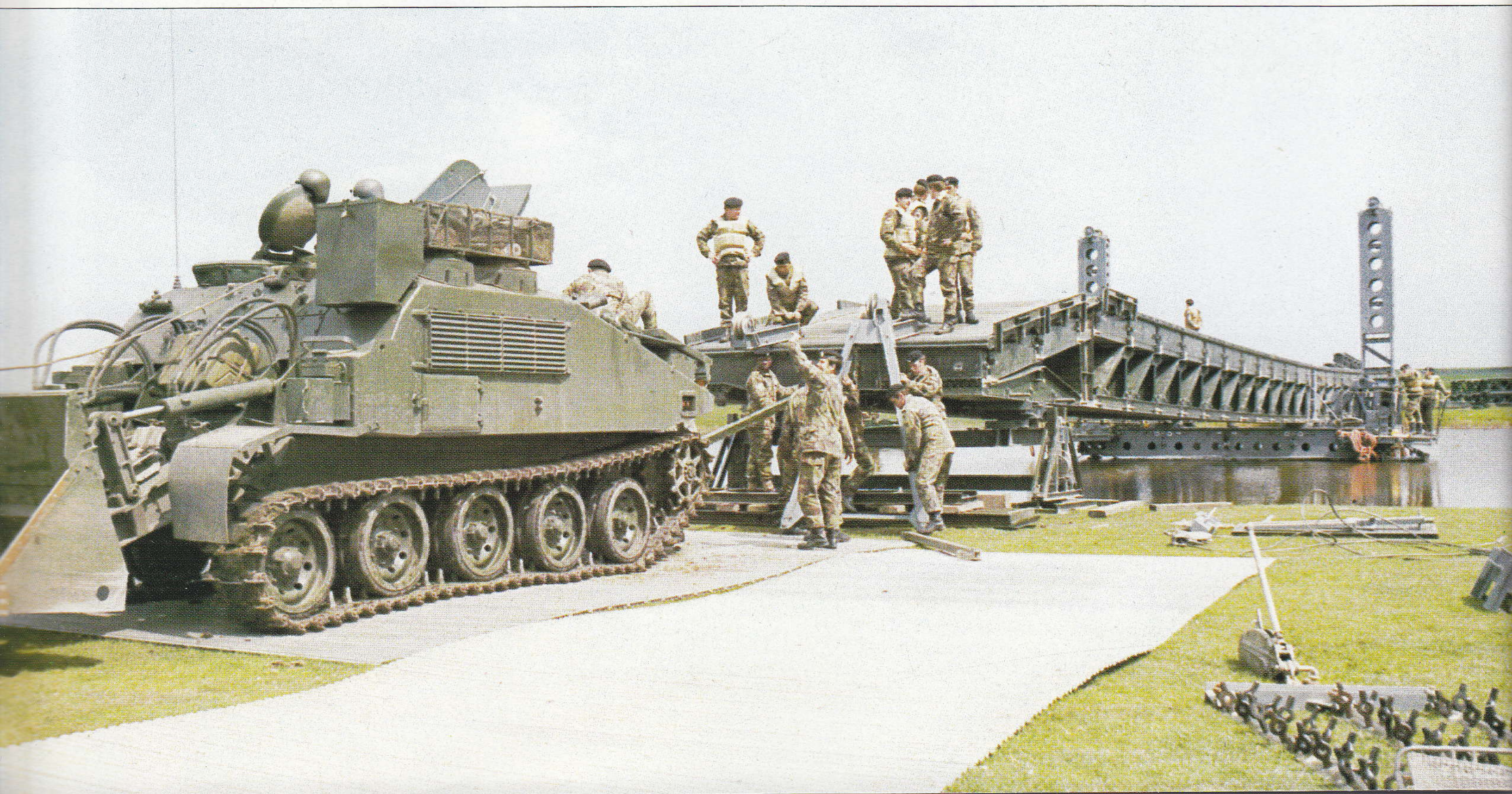
So the Sappers at the Weser are not simply trying to deny the 3rd Shock Army access to the entire west bank, but are tasked with the role of ensuring that if the 3rd Shock Army does cross, it will be at a time and a place of NATO's own choosing. For that reason, the Sappers may leave one bridge standing. They may leave one potential river crossing site a little less destroyed than the others. They may leave one major highway more usable by tanks and armoured personnel carriers than others to its north and south.

And this poses the enemy commander a very awkward problem. Even if he knows (and undoubtedly he does) what is being done to him, what can he do about it? If he ignores the 'gift' offered and attempts to fight through on a front of his own choosing, setting up his own river crossing points, he is going to suffer casualties. If he accepts the 'gift' offered he is also going to suffer casualties. If he does allow his advance to be narrowed, he faces fire from both flanks. If he does not, he runs the risk of having various units slowed or even forced on the defensive, and that can lead to counterattack. And the enemy commander is probably (hopefully) as unwilling to use tactical nuclear weapons at this stage as is his NATO counterpart.

Incidentally, it is worth remembering that one of the reasons that the British Expeditionary Force managed to evacuate so many men at Dunkirk was because the advancing German Panzers were being attacked from the flank as well as the front, which was made easier by the fact that the Panzers used to attack on a comparatively narrow front.

But back on the River Weser, one can appreciate that while the Sappers are acting in a tactical battlefield role, their actions also have enormous strategic significance. As combat engineers their role is to do just that: engineer a situation whereby combat takes place in the most favourable circumstances, and NATO is fortunate that the Royal Engineers do this superbly well.

One of the many roles performed by the Combat Engineer Tractor is the preparation of river banks for bridging by pontoons. Here the CET, having done its job, waits as the pontoon bridge is fitted into position.



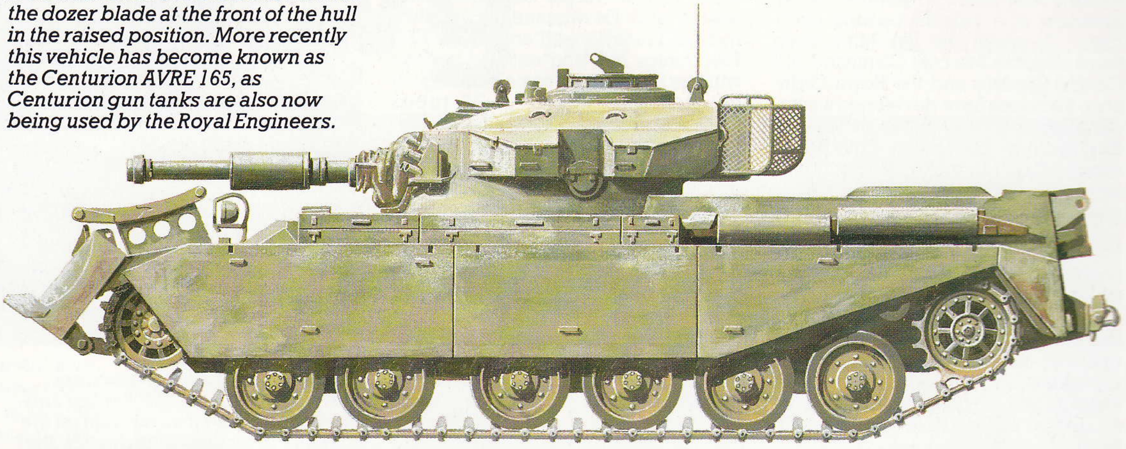
UK

Centurion Mk 5 AVRE

During World War II the British 79th Armoured Division employed a large number of specialized vehicles which were successfully used during the D-Day landings and the subsequent push through France and on into Germany. One of these vehicles was the Churchill Assault Vehicle Royal Engineers (AVRE), which was fitted with a demolition gun for destroying battlefield fortifications such as pillboxes; it could also carry on its hull front a short assault bridge or a fascine. The latter was a large bundle of wood which could be dropped into enemy anti-tank ditches so that tracked armoured vehicles could cross.

The Churchill AVRE continued in service with the British army after the end of World War II, but by the mid-1950s these vehicles were becoming difficult to maintain and operate as the basic Churchill gun tank had by then been phased out of service.

A Centurion Mk 5 AVRE is shown with the dozer blade at the front of the hull in the raised position. More recently this vehicle has become known as the Centurion AVRE 165, as Centurion gun tanks are also now being used by the Royal Engineers.



The Churchill AVRE was finally replaced in the 1960s by the **Centurion Mk 5 AVRE**, which was based on the chassis of the Centurion Mk 5 tank. The main armament of the Centurion Mk 5 AVRE is a 165-mm (6.5-in) demolition gun, which fires a high explosive squash-head (HESH) projectile to a maximum range of about 2400 m (2,625 yards), although its effective range is a good deal less than this figure. Co-axial with the 165-mm gun is a 7.62-mm (0.3-in) machine-gun, and a similar weapon is located on the turret roof for anti-aircraft defence. Mounted at the front of the hull is a hydraulically-operated dozer blade which can be used to clear battlefield obstacles or to prepare fire positions. The vehicle can also carry and lay a length of Class 30 or 60 aluminium trackway across muddy ground so that following wheeled vehicles will not become bogged down. A fascine can also be carried on the front of the hull. The Centurion Mk 5 AVRE can also tow a special trailer carrying additional engineer supplies, for example explosives or extra 165-mm rounds, or a trailer for the Royal Ordnance Giant Viper mine-clearance system.

More recently the Centurion Mk 5 AVRE has been fitted with mine-clearing ploughs at the front of the hull: when a minefield has been detected the ploughs are lowered to the ground hydraulically in front of each track and the tank is driven forwards, the ploughs then ripping up the ground and pushing any anti-tank mines to one side. These mine ploughs, developed to meet the requirements of the British army by T.B. Pearson and Sons Ltd, are also being fitted to Chieftain Armoured Vehicle-Launched Bridges of the Royal Engineers.

Centurion Mk 5 AVREs are used by armoured engineer squadrons based in the British Army of the Rhine. As there are now insufficient of these vehicles to go around, a number of Centurion gun tanks with 105-mm (4.13-in) L7 series guns are now being fitted with the plough mine-clearing devices and issued to the Royal Engineers. These are known as **Centurion AVRE 105** vehicles.

Specification

Centurion AVRE

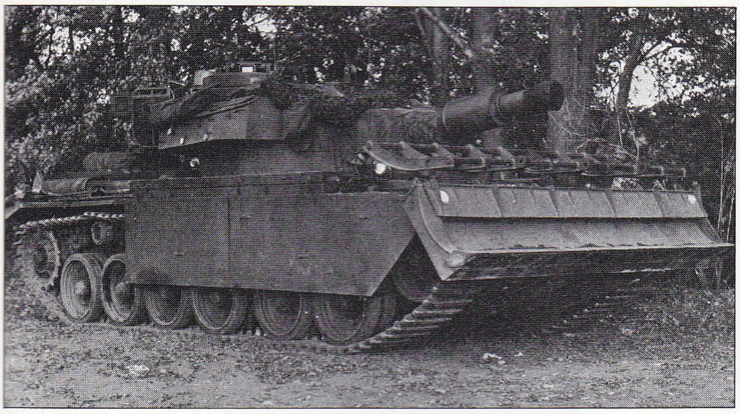
Crew: 5

Weight: loaded 51809 kg (114,220 lb)

Powerplant: one Rolls-Royce Meteor Mk IVB 12-cylinder petrol engine developing 484.7 kW (650 bhp)

Dimensions: length 8.69 m (28 ft 6 in); width 3.96 m (13 ft 0 in); height 3.00 m (9 ft 10 in)

Performance: maximum road speed 34.6 km/h (21.5 mph); maximum road range 177 km (110 miles); fording 1.45 m (4 ft 9 in); gradient 60 per cent; vertical obstacle 0.94 m (3 ft 1 in); trench 3.35 m (11 ft 0 in)



This is a Centurion Mk 5 AVRE of 32 Armoured Engineer Regiment stationed in the British Army of the Rhine. The dozer blade is in the raised position, with the device above this on the hull front being used to carry a fascine which can be quickly dropped in anti-tank ditches.

Main armament of the Centurion Mk 5 AVRE is a short-barrelled 165-mm demolition gun which fires a HESH (High Explosive Squash Head) projectile to knock out pillboxes and other battlefield fortifications. It can also tow a Giant Viper mine-clearing system.

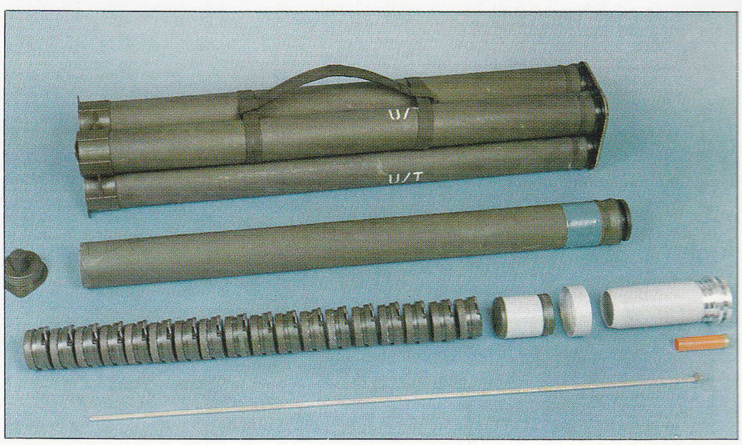
UK

Bar and Ranger Mine Systems

Bar Mine

For many years the Mk 7 was the standard anti-tank mine of the British army. This circular anti-tank mine has now been largely replaced by the **Bar Mine** which was designed by the Royal Armament Research and Development Establishment at Fort Halstead, production being undertaken by the Royal Ordnance Factories. The Bar Mine system is composed of two main parts, the mine itself and its mechanical layer.

The Bar Mine is of virtually all-plastic construction with just a few metallic components in its fuse. This feature makes it very difficult to detect with standard mine detectors. The long shape of the Bar Mine not only doubles the chance of it being run over by a tank and therefore being activated, but also means that less mines are required than of the older Mk 7. The Bar Mine is normally fitted with an



The Thorn EMI Ranger anti-personnel mine system includes 72 tubes, each containing 18 mines. The tubes are in magazines of four barrels (top) which can be quickly reloaded. Below the magazine is one of the tubes, and below this are its contents including the mines themselves.

impulse fuse which is operated by the pressure of a vehicle passing overhead. To make the Bar Mine even more effective Marconi Command and Control Systems and the Royal Ordnance Factories have developed a number of add-on fuses, and with these the Bar Mine is called the **Full Width Attack Mine**. In combat use, Bar Mines with different fuses would be laid to make clearance more difficult.

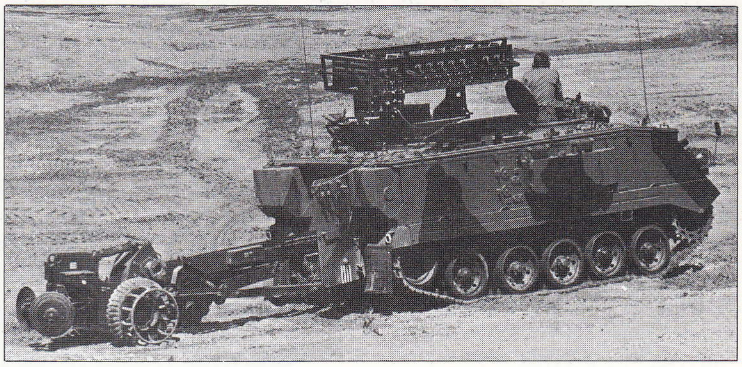
The Bar Mine can be laid by hand, but is normally laid by the Bar Minelayer built at the Royal Ordnance Factory Nottingham. This is towed by a truck or an armoured vehicle such as the FV432 armoured personnel carrier. The mines are placed on a loading chute and armed as they pass through, and are then buried under the ground, so making detection more difficult.

The laying rate depends on the type of soil, but is normally between 600 and 700 mines per hour.

Ranger anti-personnel mine system

The **Ranger** system was developed to meet the requirements of the British army by the Royal Armament Research and Development Establishment at Fort Halstead and Thorn EMI Electronics Ltd, and entered service with the British army some years ago. It consists essentially of 72 tubes mounted on a frame which can be carried on top of a vehicle such as the FV432 armoured personnel carrier, or mounted in the back of a truck or other load carrier. The tubes are mounted in magazines of four, each tube containing 18 circular Ranger anti-personnel mines; each of these is 62 mm (2.44 in) in diameter and 32 mm (1.26 in) deep. The operator has a firing unit connected to the launcher and each time a button is pressed a cartridge is fired and 18 Ranger anti-personnel mines are ejected to a distance of up to 100 m (328 ft) depending on wind conditions. The launcher can be elevated and traversed as required. The mine is not armed until 20 seconds after it leaves the launcher and then lies on the ground until it is activated by pressure. Special training mines of compressed peat are also available.

In the Royal Engineers an FV432 armoured personnel carrier tows a Bar Minelayer while a Ranger anti-personnel minelayer is mounted on the roof. This enables a combined anti-tank/anti-personnel minefield to be laid very quickly, so making clearance of the minefield very difficult and time-consuming.



This FV432 armoured personnel carrier has a Thorn EMI Ranger anti-personnel minelaying system on the roof and tows a Royal Ordnance Bar minelaying system at the rear. This combination enables a deadly combined anti-tank and anti-personnel minefield to be laid.

Specification

Bar Mine

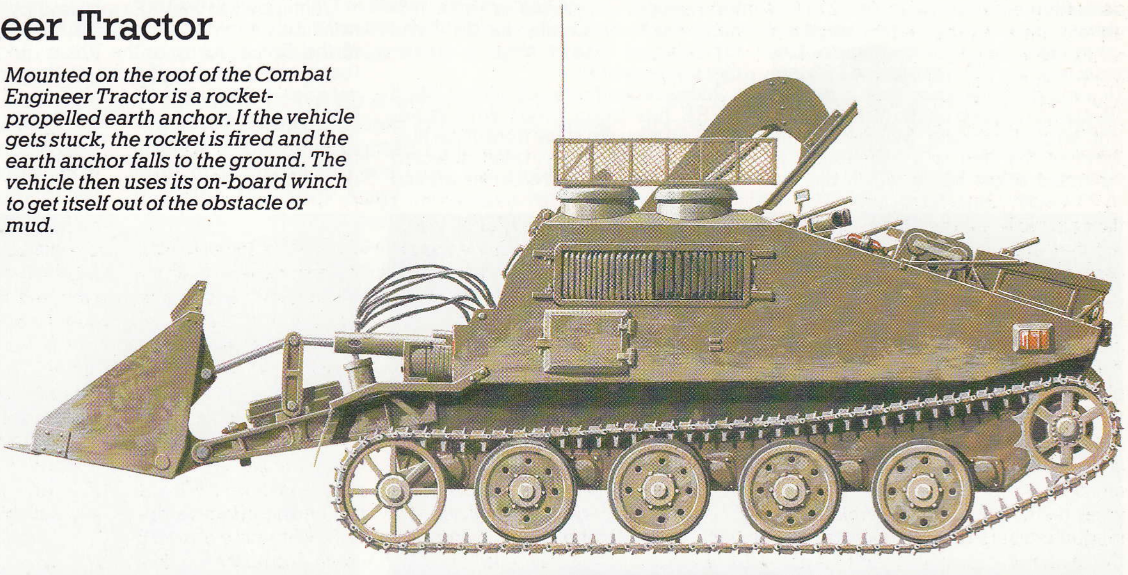
Weight: total 11 kg (24.25 lb) explosive 8.39 kg (18.50 lb)

Dimensions: length 1.194 m (3 ft 11 in); width 108 mm (4.25 in); height 82.6 mm (3.25 in)

UK

Combat Engineer Tractor

Mounted on the roof of the Combat Engineer Tractor is a rocket-propelled earth anchor. If the vehicle gets stuck, the rocket is fired and the earth anchor falls to the ground. The vehicle then uses its on-board winch to get itself out of the obstacle or mud.



The **Combat Engineer Tractor (CET)** was designed by the Military Engineering Experimental Establishment to meet the requirements of the Royal Engineers for a vehicle that would combine the characteristics of an armoured vehicle and an earthmover. At one time France, the UK and West Germany were to have worked together on such a type, but in the end each country went its own way. Two test rigs to prove the basic concept were built in the late 1960s by the Royal Ordnance Factory Leeds, and these were followed by seven prototype vehicles in 1973-4. In 1975 the CET was accepted for service with the Royal Engineers, and a total of 141 vehicles was subsequently built at the Royal Ordnance Factory Nottingham between 1978 and 1981. In 1984 India placed an order for a quantity of CETs, so production will soon get under way again.

The CET can carry out a wide range of roles such as the recovery of damaged and disabled vehicles (especially at river crossing points), the clearance of fire positions, the preparation and clearance of obstacles, the preparation of river banks, and so on.

The vehicle is normally driven with its hydraulically-operated bucket to the rear. The bucket can be used for normal earthmoving duties or bulldozing, or as an earth anchor when the 8000-kg (17,637-lb) winch is being used.

Mounted on top of the hull is a rocket-propelled self-emplacing earth anchor. Should the CET become stuck in mud or a river, the earth anchor is fired, this falling to the ground about 90 m (295 ft) from the vehicle. The CET can then winch itself out of trouble.

The vehicle can ford to a depth of 1.83 m (6 ft 0 in) but with some preparation can be made fully amphibious, so making it especially useful during water crossings. When afloat the CET is propelled by two waterjets mounted one on each side of the hull. Standard equipment includes six smoke dischargers and an NBC system, which allows the vehicle to work in a contaminated area.

The CET can also tow the trailer-mounted Giant Viper mine-clearance system, and can be fitted with a number of kits for different roles. These latter include a jib crane attachment installed in the bucket, Class 30 or 60 aluminium trackway, and a pusher bar for launching pontoons.

The CET was used by the Royal Engineers for a wide range of roles during the Falklands campaign, and parts of the chassis are being used for a 122-mm (4.8-in) D-30 self-propelled gun developed by the Royal Ordnance Factory Leeds to meet the requirements of the Egyptian government.

The Combat Engineer Tractor is considered to be one of the most useful vehicles in service with the Royal Engineers today.

Specification

CET

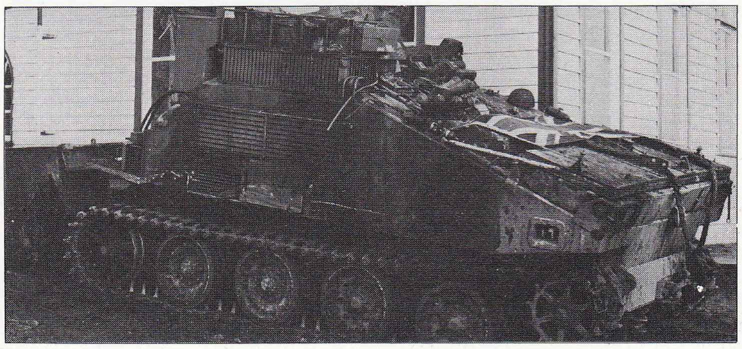
Crew: 2

Weight: 18000 kg (39,683 lb)

Powerplant: one Rolls-Royce C6TFR 6-cylinder inline diesel developing 238.6 kW (320 hp)

Dimensions: length (overall) 7.54 m (24 ft 9 in); width (overall) 2.90 m (9 ft 6 in); height (overall) 2.67 m (8 ft 9 in)

Performance: maximum road speed 56 km/h (35 mph); maximum water speed 8 km/h (4.9 mph); maximum range 322 km (200 miles); fording 1.83 m (6 ft 0 in); gradient 60 per cent; vertical obstacle 0.61 m (2 ft 0 in); trench 2.06 m (6 ft 9 in)



The Royal Ordnance Combat Engineer Tractor was deployed by the Royal Engineers to the Falkland Islands in 1982. A total of 141 was built by Royal Ordnance Nottingham by 1981, but production has since resumed to meet an order placed by the Indian Army in 1984 for 15 vehicles.

Armed Forces of the World

Soviet Navy

Part 3

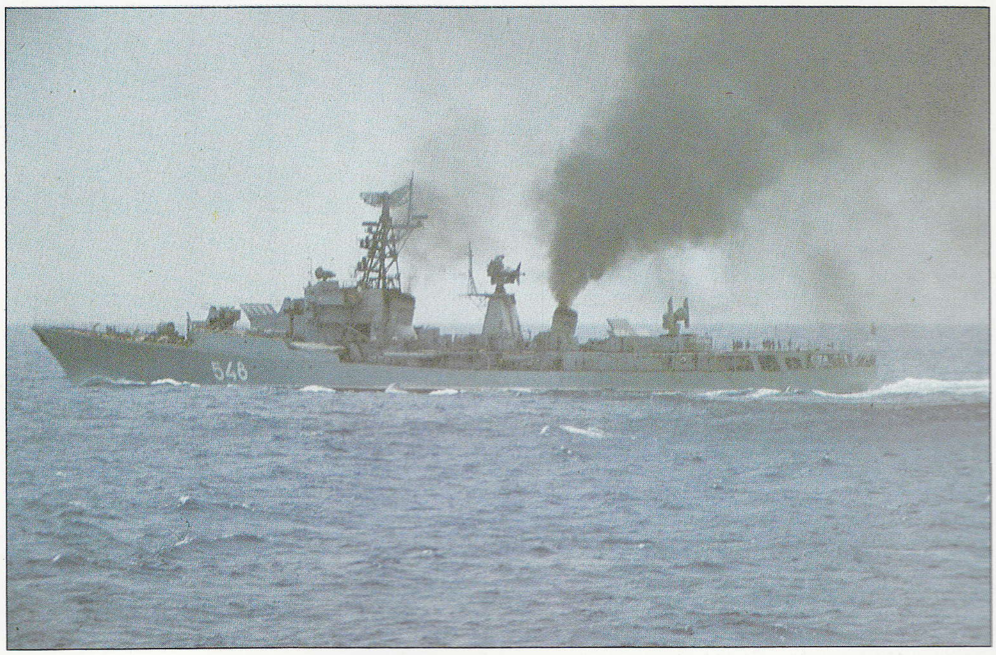
Although well furnished with surface combatants, the Soviet navy actually considers these ships to be auxiliaries for use in support of its primary arms, namely the naval aviation and submarine forces. According to their size and role, the warships are divided into groups (for small ships only), brigades (for groups of small ships and medium-sized units), and divisions and squadrons (for the largest units available).

The four 'Kiev' class aircraft-carriers and the two 'Moskva' class helicopter cruisers currently available provide both the afloat ASW rotary-wing forces and the experience required eventually to operate the follow-on 'Kremlin' class of nuclear-powered fixed-wing aircraft-carriers, of which the first is under construction at Nikolayev (Shipyard No. 444) next to a third 'Ivan Rogov' class LPD. The vessel is expected to enter operational service in the late 1980s.

To back up the carriers the Soviets have in service two nuclear-powered 'battle-cruiser' strike cruisers, the *Kirov* and *Frunze*, with a third unit of the type under construction. Although basically of the same design, the individual ships differ somewhat in equipment and armament outfits. Their role appears to combine the surface escort and strike mission with command and control flagship duties, for which they carry extensive communications systems. For surface action groups in which a 'Kirov' is not available, the Soviets have built the new 'Slava' class of gas-turbine powered missile cruiser (*raketnyy kreyser*). Fitted with similar but less extensive flagship facilities, the 'Slavas' will work closely with the new gas-turbine powered 'Udaloy' class ASW destroyers and the steam-turbine powered 'Sovremenny' class surface warfare destroyers, which are currently in series production at the Soviet navy's major shipyards. The older 'Kara' and 'Kresta II' class ASW cruisers, which the 'Udaloys' are supplementing, will remain in service for many years yet, possibly with major mid-life refits. The even older 'Kynda' and 'Kresta I' missile-armed anti-ship cruisers will also continue in service in those fleet areas where enemy offensive capabilities are somewhat restricted. A few 'Sverdlov' class 152-mm (6-in) gun cruisers remain in active service to provide the nucleus of naval gunfire support groups for amphibious warfare units.

The comparable vintage 'Skory' and 'Kotlin' class conventional gun and torpedo destroyers have also been retained in some areas for this role, while the 35 or so obsolete 'Riga' class frigates are now being phased out or reduced to reserve status on a gradual basis. Replacements in the form of the light ASW frigate 'Grisha III' class and the larger helicopter-carrying 'Krivak III' frigate (which replaced the 'Krivak I' and 'Krivak II' designs on the building stocks) are being acquired at accelerated rates. To aid both coastal and oceanic ASW elements the Soviets maintain a number of SAM-equipped destroyers of the 'Kashin', 'Kanin' and 'SAM Kotlin' classes. There are also six 'Kashin (Mod)' and three 'Kildin (Mod)' destroyers fitted with aft-firing anti-ship cruise missiles; these ships operate in the 'tattletale' target-designating role with the fleet of intelligence-gathering vessels as part of the Soviet navy's ocean surveillance system.

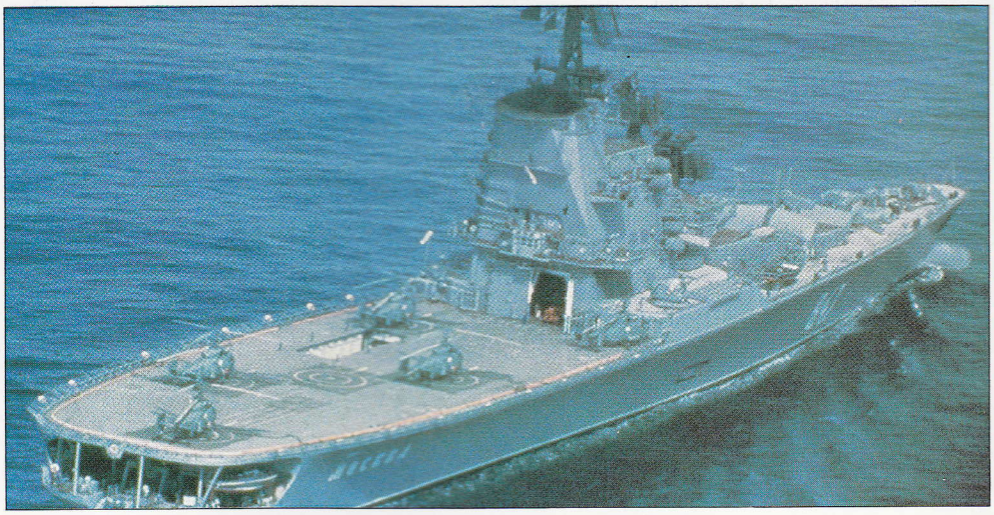
Numerically the most important part of the Soviets' surface-warship force remains its mixed complement of small ASW and torpedo- or missile-armed coastal craft. The most important of these are the 'Osa I' and 'Osa II' classes of missile boats, the 'Nanuchka' series of small missile ship, and the 'Poti' class of coastal ASW vessel. Most of the older classes such as the 'Osa I' and 'Poti' are undergoing gradual replacement by new designs such as the 'Tarantul' class small missile ship and the 'Pauk' class small ASW craft.



Converted from 'Krupnyy' class SS-N-1 anti-ship missile-carrying vessels, the eight 'Kanin' class received a twin SA-N-1 Goa SAM launcher aft.

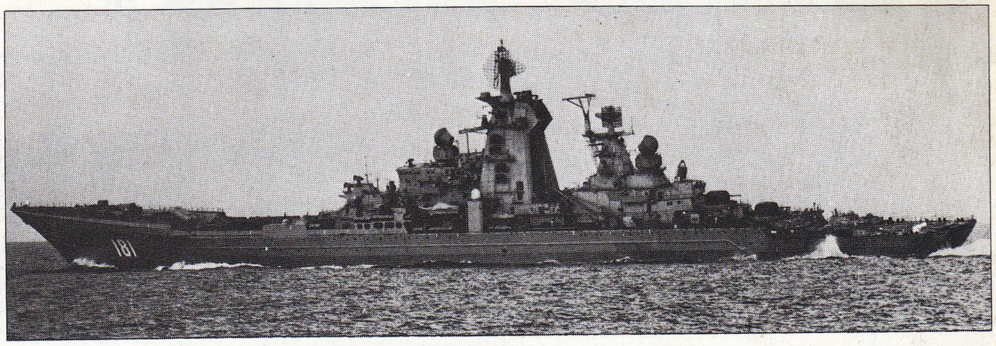
Also designated as an adjunct to the Soviet navy's main strike elements are the amphibious warfare forces. The Baltic, Northern and Black Sea Fleets each have a naval infantry (*morskaya pekhota*) regiment. This is similar in concept to a motor rifle regiment of the Soviet army, but is in practical terms equivalent in capabilities to a motor rifle division. The major difference is that the naval infantry are fully trained in all aspects of amphibious warfare operations, including assault landings, and have special equipment in the form of transport ships and air-cushion vehicles (ACVs) to permit effective operations well away from the Soviet homeland and across all types of coastal terrain. Normally a regiment has three 400-man motorized infantry battalions (each with 34 BTR-60 wheeled APCs), a tank battalion of one medium and three light amphibious tank companies (equipped with 31 PT-76, seven T-55 medium and three T-55 flamethrower tanks) plus supporting units. The regiment can be broken down to give three independent battalion landing teams, each with its own light tank company and/or medium tank support.

The Pacific Fleet has a brigade-sized naval infantry unit attached to it (which US intelligence sources generally describe as a 'division'). This comprises two tank battalions, five motor rifle battalions, and support units which include an amphibious self-propelled howitzer battalion of 18 122-mm (4.8-in) 2S1 guns, a type found in the other fleet areas in only a single six-gun battery.



The 17,000-ton cruiser* Moskva *entered service in 1967, followed a year later by her sistership* Leningrad. *Carrying 18 Kamov Ka-25 helicopters, the class represented a significant augmentation of Soviet anti-submarine capability.

12 PASS



This is one of the first pictures ever released of the missile cruiser Kirov, *taken on her trials in the Baltic as she undergoes a high speed turn.*

In the last year or so further improvements to the naval infantry have been observed, these including the addition of a T-72 main battle tank company to the tank battalion as a means of improving its anti-armour capabilities, the introduction of the AT-4 'Spigot' and AT-5 'Spandrel' ATGWs to replace the AT-3 'Sagger', the addition of SA-13 'Gopher' and SA-14 SAMs initially to supplement and then to replace the SA-9 'Gaskin' vehicle and SA-7 'Grail' shoulder-launched systems, and the adoption of the new generation of 5.45-mm (0.215-in) small arms and infantry support weapons.

Each fleet also has a brigade of Spetsnaz diversionary troops, under the direct command of the Intelligence Directorate at naval headquarters. Tasked primarily with attacking enemy naval installations (including nuclear submarine bases) the Spetsnaz operate from surface ships (including trawlers converted to carry swimmer-delivery vehicles, midget submarines and high-powered small craft), large submarines (including the mini-submarine mothership 'India' class of rescue submarine) or aircraft as required.

Each brigade is divided into a headquarters company of specialist assassination and sabotage experts, a signal company, a parachute battalion, two or three combat swimmer battalions and a division of 12-18 midget submarines. There are also another 20 or so company-sized units attached to the fleets, and these are tasked with specific assassination and sabotage missions.

For coastal defence the fleets have regiments and independent battalions of the navy's Coastal Rocket and Artillery Troops armed with both stationary and mobile missile launchers and artillery weapons. Their task is to provide defence for the approaches to principal naval bases and ports. As the Soviet navy adopts the same reserve system as the Soviet army, in wartime the number of naval infantry and Spetsnaz units would be doubled within a matter of a few days as each individual formation has an 'invisible' double of the same size staffed by additional officers. Each such formation serves in peace with the parent unit, and is equipped with reservist enlisted men and NCOs, operating older equipment from the navy's war reserve stocks.

To transport the naval infantry overseas, there are two 'Ivan Rogov' class LPDs, 31 'Ropucha' and 'Alligator' class LSTs and 50 of so 'Polnocnyy' class LSMs. These are being backed up in areas near NATO targets and the Japanese islands by an increasing number of small, medium and large ACVs, which are taking the place of the more conventional tank and personnel landing craft.

A major area in which the Soviet navy is considered highly by most Western analysts is in mine warfare, a field in which both the US and Royal Navies are currently lacking, principally in terms of offensive weapons and numbers of countermeasure vessels. With nearly half a million sea mines of all types in its inventory, the Soviet navy has the potential literally to close Western European waters to any major movements of shipping, which makes an effective mockery of the various NATO statements mentioning resupply by sea.

The main offensive laying platforms in wartime would be aircraft of the Soviet naval aviation fleets, with conventional submarines, converted trawlers and merchant ships providing an extensive covert laying capability in any period of tension before the outbreak of hostilities. Defensive fields to protect Soviet bases and transit routes would be laid by the surface combatants and maritime patrol aircraft, the majority of which have inbuilt minelaying capability.

The main ground mine types are the aircraft-laid 500-kg (1,102-lb) AMD-500 and the aircraft-, submarine- or ship-laid 1000-kg (2,205-lb) AMD-1000, both of which may be fitted with a magnetic, acoustic, pressure or combination type influence fuse. To support these weapons is a small quantity of nuclear sea mines, plus a large number of older moored types such as the MO8 and MKB contact, the MAG antenna, the KRAB influence, and the MZ26 sweep obstructor devices. All of these (with the exception of the nuclear type) are probably also used by the Warsaw Pact navies and by the more favoured Soviet client states. For their own use the Soviets have also developed special ASW mines under the titles Rising Mine and Sectionalized or Electrical Potential Mine. Both are apparently laid by submarine and are targeted against NATO's nuclear submarines. A completely new ground mine type has been developed, and reduced-charge versions with magnetic and acoustic firing mechanisms were used recently by what is believed to be Libya to mine the Red Sea.

To match their minelaying capacity the Soviets also use the largest number of mine-countermeasures vessels amongst the world's navies. These are divided into three basic types: the sea-going minesweeper (*morskoy tral'schchick* or MT), the base minesweeper (*bazovyy tral'schhchik* or BT) and the roadstead minesweeper (*raydovoy tral'schchik* or RT). The first operates as part of the fleet during open-ocean operations, and often has secondary ASW capabilities, whilst the latter two are equivalent to NATO's coastal and inshore categories of minesweepers respectively. They use underwater TV sleds, minehunting sonars, unmanned radio-controlled drones, mine disposal divers and submersible mine identification and disposal craft (together with the more conventional towed wire, magnetic loop and acoustic generator sweeps) to achieve their aims.

All four fleet areas have large numbers of minesweepers, and would be able to keep open the major proportion of the ports and bases within their areas in the face of a determined offensive minelaying campaign, as well as to support fleet operations in enemy-controlled waters.

The 'Kresta I' missile cruiser class, consisting of four units, were the first Soviet surface combatants to have a helicopter hangar fitted.